Industry Power

A Putman Publication | "Executive Magazines for Industry"

JULY 1956

For Men Who Manage

Power Services

EXCLUSIVE INTERVIEW: **WILLIAM F. CRAWFORD**, president, Edward Valves, Inc., subsidiary of Rockwell Manufacturing Company discusses pioneering and power plants — see page 3

$1.00 the copy

COPPUS "BLUE RIBBON" VENTILATORS

identified by the blue band

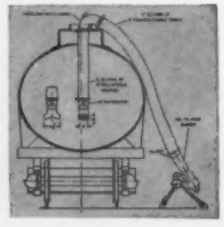
FOR WORKERS'
- Safety
- Health
- Comfort
- Efficiency

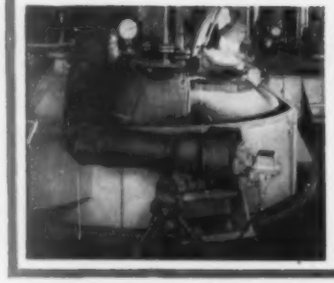
VANO® Design "A" VENTILATOR

Vano Design "A" cooling interior of furnace, supplying fresh air through 10 feet of "Ventube" to provide safety and comfort during repair work.

Vano Design "A" delivering fresh air to cable manhole, expelling sewer gas, making entrance safe in a few minutes.

Vano Design "A" Ventilator plus a few accessories feeds large air volume into tank car, driving out fumes, stagnant or hot air for workers' safety and comfort.





Vano Design "A" supplying fresh air in Reactor Room of Synthetic Rubber Plant.

Vano Design "A" Ventilator supplying fresh air to men working in wing compartments, fuselages, etc.

Powered by a ½hp motor, and equipped with the exclusive Coppus axial-flow propeller-type fan, this general-purpose blower delivers 1500 CFM of fresh air. It supplies ventilation for tanks, tank cars, drums, vats, underground cable manholes, pipe galleries, airplane wing compartments and fuselages, and other confined places. Weighs only 103 lbs. Uses 8"-diameter flexible canvas tubing ("Ventube").

VANO DESIGN "C"

VENTILATOR-EXHAUSTER

Vano Design "C" equipped with 8" discharge tubing removing welding fumes.

Vano Design "C" equipped with two suction lines removing welding fumes for operators' safety.

For withdrawing welding fumes from confined places or directly from the welding rod ...or for expelling fumes or hot air from enclosed vessels. You can get it with 8" suction inlet for 8" non-collapsible tubing ...or with multiple inlet nozzles for 5", 4" or 3" suction hose. The discharge outlet takes 8" "Ventube". Powered by a ½hp motor, it weighs only 85 lbs.

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(Write here any special ventilating problem you may have.)

COPPUS "BLUE RIBBON" PRODUCTS—Designed for Your Industry, Engineered for You

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late news

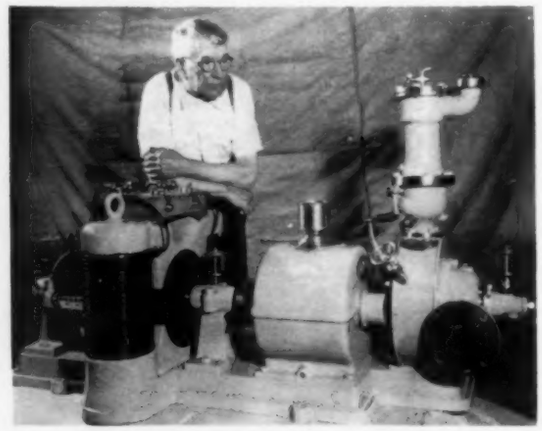
. . . about industry power

● Instrumentation Division voted by AIEE

Because of the increased importance of instrumentation in electrical engineering, a sixth major technical division of the AIEE, to be known as the Instrumentation Division, has been approved by the Board of Directors. New division, of which C. F. Savage, Jr., General Electric Company, New York, has been named chairman, will begin operations August 1. At present it is part of the Science and Electronics Division, and is known as the Committee on Instruments and Measurements.

● You can't hardly get them kind, no more!

Turbogenerator set made by De Laval Steam Turbine Co., and displayed at 1893 Chicago World's Fair was recently shipped to the Smithsonian Institution in Washington, D.C. Set will be displayed in the new Power Hall, which will open late this fall. Generator was the first set to produce electric current on a commercial scale in the U. S. Turbine delivered 10 horsepower at 24,000 rpm.



● First recipients of BCR award

Stanley H. Langer, Charles Zahn, and Irving Wender, of the U. S. Bureau of Mines, Bruceton, Pa., were named recipients of the Bituminous Coal Research, Inc., Award. Award was given for the best paper pertaining to coal at the Spring Meeting of the American Chemical Society in Dallas, Tex. Their coauthored paper, first to be selected for the new BCR Award, was presented by Langer, and was entitled "The Chemistry and Structure of Coal: I. Optical Activity in Oils Derived from Coal."

● Air-conditioning industry gets a blast

Newly elected president of the Air Conditioning and Refrigeration Institute, Matthew M. Lawler, recently declared that some companies in the industry are misleading the public with "extravagant claims, creating

Industry Power

A PUTMAN PUBLICATION

Commercial Bank Building, Saint Joseph, Michigan

VOLUME 71 NO. 2 JULY 1956

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INDUSTRY POWER ***forum***

from an exclusive interview . . . .

pioneering and power plants

as told to Harold A. Bergen, Editor

RESPONSIBILITY FOR PIONEERING the technology of better power plants continues shifting, as in recent years, to the owner-operator. It is becoming progressively more difficult for the American power equipment manufacturer to underwrite innovation in response to the desire or whim of the individual customer—whether or not his innovation is a sound development from an engineering or marketing standpoint.

Now, one secret of American productivity and our high standard of living is the great capital investment in plant equipment. It is such equipment, progressively more specialized, but operated by individuals lacking the old "job-shop" versatility, that permits us to compete in spite of wage rates three to five times greater than elsewhere.

Yet, this necessary dependence on mass production tools makes it expensive and disruptive for a manufacturer to build *pioneering* power equipment to individual requirements, in limited lots. So, the cost of risk-taking shifts increasingly to the shoulders of the owner-operator—with the possible exception of a dwindling number of very large manufacturers whose income is derived from diverse markets, and who can spread the cost of innovating. Twenty-five years ago, we had numerous sources for supplying a *pioneering* turbine development. Today, we have fewer than can be counted on the fingers of one hand. Similarly, this situation applies to a *pioneering* boiler, pump, or valve.

Another factor in pioneering today's power equipment frontier is that really valid test results are largely obtained only from full-scale operating experience. Few, if any, equipment manufacturers can afford a huge prime mover test unit. So, we find responsibility for extending the limits of temperature, pressure, and size to be resting most heavily on the owner-builder.

In the relatively simple field of power plant valves, there are very difficult engineering-economic problems in meeting the new high-pressure, high-temperature operating conditions. For example, the new superpressure installations will, in our opinion, be faced with difficult, and perhaps unanticipated material and design problems. In our supercritical pressure steam valve research (extending over more than a decade) we are confronted with phenomena for which we find no technical data available anywhere. When you multiply this problem by the other major equipment categories in supercritical plants, the owner appears to have a long, difficult row to hoe.

While the nuclear power plant, the large gas turbine, and the very-high-pressure temperature steam generator (10,000 psi at 1400 F routine in 1975) are inevitable, the owner-operator will have to pay for an increasingly larger share of pioneering power equipment development. One alternative is government-financed research, but history proves that this further complicates the economic position of all private business, equipment manufacturer and power producer alike. So, the power industry is faced with a dilemma that requires superior supplier-owner cooperation. The long-proven advantages of standardization and simplification become increasingly more important. The farsighted equipment manufacturer can, and does employ an ever larger percentage of income for research and new product development, much of which is necessarily unprofitable today. He is attempting in many ways to solve the problem of producing pioneering equipment. At the same time, the owner-operator, and his consulting engineers, are recognizing the new cost considerations facing manufacturers—high research expense, complex personnel situations, vendor considerations, and the difficulties of processing *pioneering* equipment in the modern, specialized, mass production manufacturing facility.

William F. Crawford, president, Edward Valves, Inc., subsidiary of Rockwell Manufacturing Co.

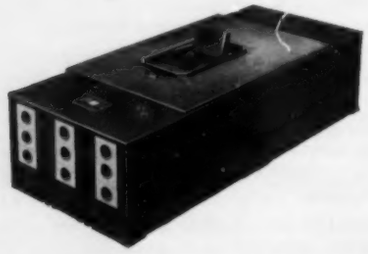
Mr. Crawford has served on the Valve Industry Advisory Committee from 1941 to 1945 and from 1950 to 1953. He is a director of Valve Manufacturers Association, Rockwell Manufacturing Company, Washington Steel Corporation, Central Scientific Company, and Edward Valves, Inc. Mr. Crawford is a member of ASME, AWS, ASNA&ME, ASM, and Newcomen.

NEW..."M" Frame Molded Case Circuit Breakers are fully designed for 800 ampere applications

Approved by Underwriters Laboratories, Inc.

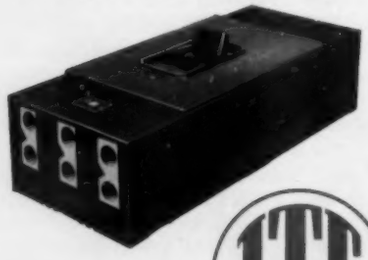
For applications which formerly required larger and more expensive equipment, you can now use the new I-T-E "M" frame molded case circuit breaker without sacrifice of quality. It offers optional pressure connectors for double or triple cable connections per phase contained within the circuit breaker case. Exclusive 3" pole center design dimensions permit easy accessibility for front cable or rear bus and stud connections. And the "M" frame breaker is ideally suited for use in panelboards, power panels, switchboards, motor controls, bus duct plugs, and individual enclosures.

Available with interchangeable trip units providing continuous 600, 700 or 800 amp ratings in 2- or 3-pole construction for 250 volt d-c and 600 volt a-c service. Interrupting ratings (NEMA test procedure): 600 v a-c, 25,000 amp; 480 v a-c, 35,000 amp; 240 v a-c, 50,000 amp; 250 v d-c, 20,000 amp. For more information, write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.



Triple cable connectors accommodate three 300-400 mcm cables per phase.

Optional double cable connectors accommodate two 400-500 mcm or 600-700 mcm cables per phase.



I-T-E CIRCUIT BREAKER COMPANY • Small Air Circuit Breaker Division

Circle 113 on READ-N-CIRCLE card for more data

late news

. . . starts on page 2

dissatisfied customers and so impeding progress." Lawler, vice president of Worthington Corporation's Air Conditioning and Refrigeration Division, said "something must be done to insure the integrity of manufacturers' ratings of equipment." He continued "any industry that cannot police itself from inside will eventually be policed from outside."

● Nuclear facilities plant outgrows itself in one week

Four days after moving into new Nuclear Facilities Plant at Lynchburg, Va., Alfred Iddles, president of Babcock & Wilcox said ground would be broken in three

days for 150-percent expansion of the new plant. Purpose of new facilities is to determine critical physical characteristics of nuclear reactors and to manufacture fuel elements for power and research reactors.

● Water treatment company cleared by FTC

A Federal Trade Commission Hearing Examiner, Abner E. Lipscomb, has issued an order that dismisses, for lack of proof, charges that Evis Manufacturing Company, San Francisco, misrepresented the operation and advantages of the Evis Water Conditioner. This is not a final decision, and may be appealed, stayed, or docketed for review. Decision was issued following extensive hearings on the merits of a Commission complaint, issued in early 1954. Complaint charged as false the company's representations that the Conditioner has special properties, will benefically treat water, and eliminate some of the destructive effects of water on pipes. Examiner ruled that there was either no evidence to support the charges or that the evidence adduced was inconclusive. Conditioner is described as an oversized type coupling with an interior post integrally cast in place, which is intended to be fitted into water systems for the purpose of benefically treating and conditioning water.

● You get a bonus with coal

Recent analysis of West Virginia coal has revealed that 36 different chemicals are present, including sodium, potassium, calcium, aluminum, silicon, iron and titanium — all in concentrations of more than one percent. So perhaps that flyash isn't worthless, after all.

A PUTMAN PUBLICATION

Industry Power

For men who manage power services

VOLUME 71 NO. 2 JULY 1956

In this issue . . .

licking noise through reverberation control 12
Reverberation is the key to noise control. Here's how San Francisco's North Point sewage plant used acoustic materials to absorb reverberation and make intolerable conditions tolerable.

graphic check on boiler economy 14
Use this unique chart to determine your fuel target and efficiency—you won't need to refer to any steam tables or data books, and it is suitable for any size of boiler burning any fuel.

relamping mercury's pays off, too 16
Planned relamping is already acknowledged as an economic necessity for fluorescents, and is proving even more of a necessity for mercury's. This example will show you how to start.

dual-fuel diesel outwits outages 19
Read how Radio Materials Corporation improved their power supply by installing a dual-fuel diesel as primary source of power. Now large load fluctuations don't affect their production.

squeeze out more power plant efficiency 20
Listen to a voice of experience telling you where to look in your search through the heat cycle to reduce your heat rate. Remember, it's that last percent efficiency that matters.

roof insulation pays out in three months 22
Here's how Magnavox reaped the economic benefits of an insulated roof, got a better roof than a re-covering job would have given, and all without any loss of valuable production time.

electrical refresher—part VI, ac machinery 24

in brief—ASME Spring meeting 31
Wood refuse spreader stoker firing; portable, 5000-kw gas turbine power plants; appraisal of nuclear versus hydro power in the Pacific Northwest.

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SMALL RATCHET PIPE THREADERS
You'll like the rifle barrel, rust resistant finish of the TOLEDO ratchet Threader—the drop head tool that lets you change dies instantly. Pull the pawl—the die drops out. Slip in another and you're ready to go. It's that easy. Check the new bright red ball end for easier handling, better grip. It's quality, like all TOLEDO tools. ⅛" to 2" sizes. See them today at your suppliers.
THE INDISPENSABLE
PORT-A-PONY
The No. 68 Power Drive will be the handiest tool on your truck. Takes power to the job—up the ladder, on the scaffold, in the ditch. Electric or air driven. Turns, threads, cranks, lifts, pulls, or rotates. Makes an ideal bench tool, too.
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FOLDING WORK BENCH
A strong, sturdy folding vise stand that sets up easily, saves time and effort. All one unit. Has three pipe benders, tool slots, pipe rest and ceiling brace. A portable work bench that meets all needs. Wt. 33 lbs.
THREADED PIPE
THE TOLEDO PIPE THREADING MACHINE COMPANY
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BUILDERS OF THE WORLD'S FINEST PIPE TOOLS
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nuclear news

. . . about industry power

EXPLAIN HAZARDS OF NUCLEAR POWER PLANT

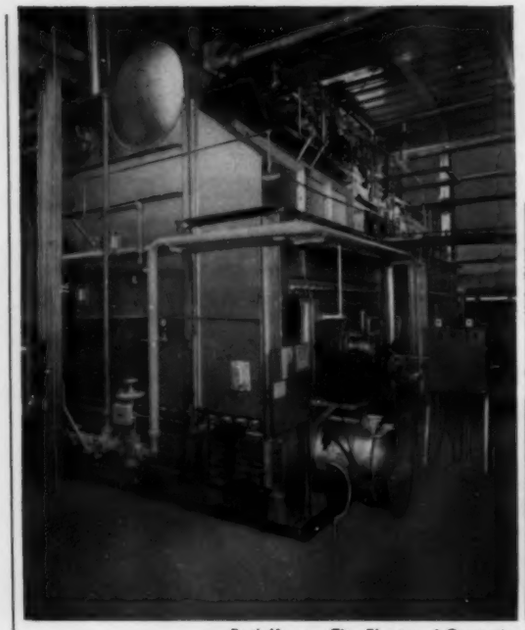
Unique health and safety aspects of nuclear power plants has been summed up in a 2-part nutshell by an AEC spokesman: first, large quantities of radioactive material will be constantly created and held in storage; and, second, nuclear power plants will contain enough fuel for months or years of normal operation. Latter characteristics demand particular attention to the control of the rate of energy released wherein the reactor would at all times contain energy representing millions of kilowatt hours at any time.

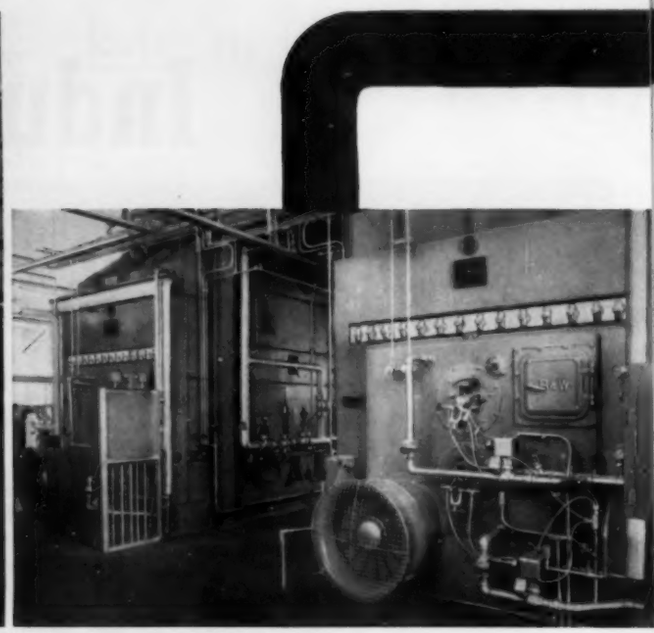
NUCLEAR STANDARDS ON THE WAY

A Nuclear Energy Standards Board has been established within the framework of the American Standards Association. Morehead Patterson, American Machine and Foundry, has been named chairman of the Planning Committee on Standardization in the Field of Nuclear Energy.

MORE FACILITIES ON THE WAY

AEC has issued a permit to Massachusetts Institute of Technology for construction of a research reactor that will operate at power levels up to 1000 kw. ACF Industries will build the reactor. Completion date will be sometime between June 1, 1957 and June 1, 1959 . . . . Babcock and Wilcox has been selected by AEC to design, fabricate, and operate a liquid metal-fueled reactor experiment, contingent on negotiation of an acceptable contract. This reactor is the seventh type chosen by the AEC's program of research and development aimed at achieving economic power from nuclear fuel . . . . Detroit Edison has lined up two engineering firms and placed orders for major equipment in its program to put its first atomic-electric power plant into reality. A 150,000-kw steam turbogenerator was ordered from Allis-Chalmers. Commonwealth Associates and United Engineers & Constructors have been retained as architectural and construction engineers, respectively . . . . AEC has awarded a contract for $8,828,900 for construction of the AEC's new headquarters



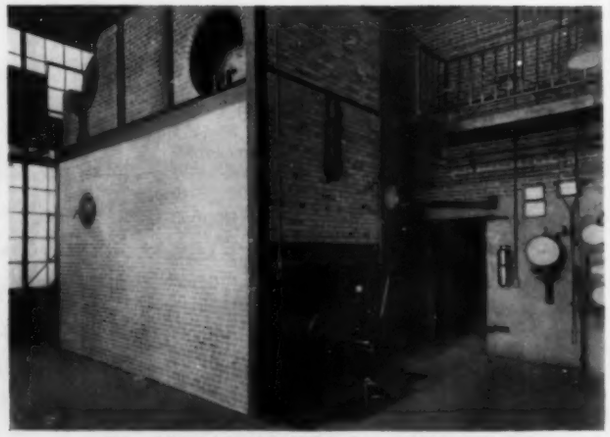


Both Kansas City Plant and Gastonia, N. C. Plant, newest of the H&D plants, have two 18,000 lb per hr boilers. The Kansas City boilers use either gas or oil depending on availability. The Gastonia boilers use oil only. All these boilers have forced-draft fans mounted directly on the burner windbox.

B&W BOILERS:

A 35-YEAR ACCEPTANCE STORY AT HINDE & DAUCH H&D

Hinde & Dauch operates corrugated box factories in major markets of the East, Midwest, and South



This oil-fired 150 HP B&W Boiler went into service in 1930, at H&D's Baltimore box factory.

The Hinde & Dauch Paper Company is one of the country's largest manufacturers of corrugated paper materials. Its remarkable growth since 1882, from a single threshing machine and straw baler, has been paced by ingenuity in adapting the product to varying conditions—virtually making markets where none previously existed.

As a leading corrugated box manufacturer, H&D requires an efficient, dependable steam source in each of its many plants scattered around the country. And since 1921, when three 516 HP B&W Boilers went into service in the company's Fort Madison, Iowa plant, The Hinde & Dauch Co., has been using B&W Boilers of various types and capacities in its plants from Watertown, Massachusetts to Kansas City, Kansas—the strongest possible indication of acceptance based on performance.

Since 1946, B&W Boilers for H&D have been of the Integral-Furnace Type. In its newest plant at Kansas City, Kansas, two B&W Integral-Furnace Boilers went into service in November of 1955. Each unit provides 18,000 lbs of steam per hr and is equipped for oil and gas firing. Some of the other H&D installations have provision for future stoker firing, to afford full benefit from fuel price fluctuations. Today there are 19 B&W Boilers in service at H&D plants, for a total of 275,000 lb of steam per hr.

For the past 35 years, Hinde & Dauch has been relying on B&W Boilers for dependable, economical steam. Like many more industrial concerns in various categories, this company has found B&W Integral-Furnace Boilers ideally suited to its steam requirements, both processing and heating. Take a tip from this long association if you are considering steam plant modernization or expansion. B&W Integral-Furnace Boilers are available in individual capacities to meet any requirements from 2900 to 350,000 lb of steam per hr.

Write for complete details to The Babcock & Wilcox Company, Boiler Division, 161 East 42nd St., New York 17, N.Y.

B&W INTEGRAL-FURNACE BOILERS

OFFER THESE 10 COST-SAVING ADVANTAGES

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler water concentration
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

BABCOCK & WILCOX

BOILER DIVISION

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G-777

building near Germantown, Maryland. The new building will house the entire AEC Headquarters staff.

FUEL CELL DEVELOPED FOR DIRECT CONVERSION

A "fuel cell" able to directly convert fission heat from a nuclear reactor into electric power without an intervening turbo-generator has been developed in England. Cell contains hydrogen, oxygen, potassium hydroxide, and sintered nickel electrodes. Reaction of the hydrogen and oxygen under high pressure produces electricity.

REACTOR RESPONDS EASILY TO TURBINE DEMANDS

Controlling nation's first experimental boiling water reactor while part of a steam system connected to a turbine system has not been difficult, according to the report of Dr. Walter H. Zinn. Dr. Zinn reported to the recent meeting of the American Nuclear Society that the response time of the reactor to normal load changes on the turbine was sufficiently slow so that reactor operation could easily match the reactor power to the demand from the turbine. This produced a marked reduction in the quantity of steam that bypassed the turbine for control purposes.

Carryover of radioactivity from the reactor to the external turbine surface has not given indication of reaching a level that would make operation or maintenance hazardous. Level of radioactivity during operation does not keep operators out of any area to which they need access. Decay of radioactivity on shutdowns was rapid and reached a level permitting direct maintenance of the turbine and associated equipment. Dr. Zinn's report covered about one year's operation of the Borax reactor at Arco, Idaho.

BRIDGING THE FUELS GAP

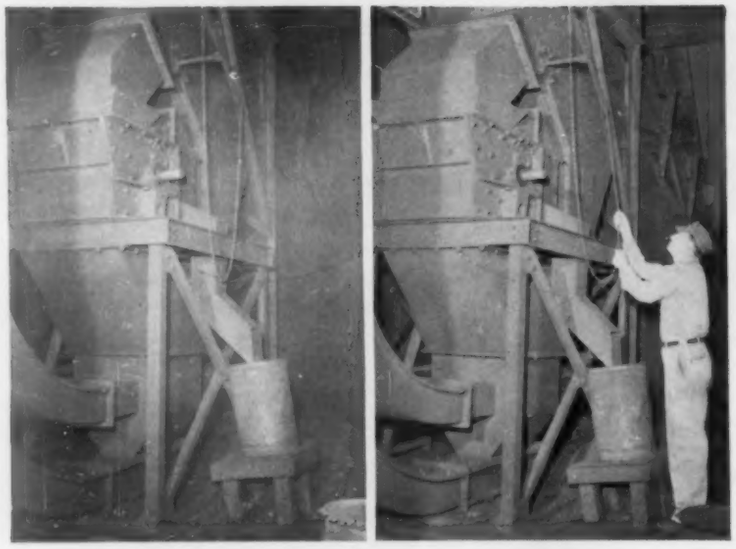
Initial atoms-for-peace power plant in the New World will be installed for the Dominican Republic on island of Hispaniola. Contract with The Glenn L. Martin Company for the nuclear-powered electric generating system is contingent on a bi-lateral agreement between the U.S. and the Dominican Republic before becoming effective.

Dominican Republic is thus the first of Latin America's power-starved countries to bridge the gap between conventional fuels and nuclear energy.

Power Plant Keeps Coal Handling

DUST FREE

from Railcar to Bunkers



BEFORE **AFTER**

This power plant in Danville, Virginia uses a **Johnson-March engineered liquid dust-control system** to eliminate troublesome coal dust in all stages of their coal handling. From railroad gondolas, where the coal is dumped on a conveyor, to the pulverizer, this plant has done away with the hazard of dust explosion, abrasion and wear and tear on their power plant equipment. Working conditions are greatly improved and maintenance time has been reduced to a minimum.

The before and after photos above are an example of the efficient manner in which the J-M system controls the coal dust in this plant. Even the efficiency of existing mechanical dust collectors can be improved by the addition of a Johnson-March liquid system.

Write today for a free analysis of your dust problem . . . no obligation of course.

Johnson March

Dust Control Engineers

1724 CHESTNUT ST., PHILADELPHIA 3, PA.

CANADIAN REPRESENTATIVES: C. F. Sterne and Sons, Ltd., Brantford, Ontario

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our readers write

. . . to industry power

Brickbat among the bouquets

Gentlemen:

May I add my congratulations to the many others upon your dramatic achievement in the ultimate design, creation, and presentation of a truly fine magazine.

H. Q. Ricker, Sr.
Building Department
City of Greenville, S. C.

Gentlemen:

WOW! Quite a change in INDUSTRY POWER this month!

I enjoyed your editorial on Page 11, although I am not in agreement that the new format possess [sic] all the advantages you claim for it. As a matter of fact, with the exception of the articles where one column of advertising can be discarded, you have made it tough for those of us who like to file articles from your magazine.

I can appreciate that Page 16 is a dream for a printer as he need not set any type. But the article is a stinker to keep in a standard size file folder. If you have any clever ideas of what to do with a 11¼ by 11¼ sheet in an 8½ by 12 file folder, I would be delighted to have them.

Thirty-four magazines each month arrive in my mailbox. Now I'm not kidding anyone that I read each from cover to cover, but I do scan all the pages and read with a sharp pocket knife in my hand to slit articles for my files. It was real nice of you to adopt the 11¼ standard height for the technical press. Please, by all means, keep it — Saturday Evening Post notwithstanding.

Frederick B. Morse, P. E.
Consulting Mechanical Engineer
West Lafayette, Ind.

● *Last thing in the world we want to do is make things tough for our readers. That's why we are publishing charts and pictures big, full-size. In that way, a chart can actually be used. For filing articles you clip, we suggest you fold the sheet to fit your file folder size—the paper used will stand folding and refolding very well.*

Gentlemen:

I think your new format is extremely effective. May I add my congratulations to the many that I am sure you will receive.

Donald R. Schoen
Vice President, Manager
Hays Division, Hays Corporation
Michigan City, Ind.

Errors caught

Gentlemen:

I very much appreciated your article titled "Electronic Equipment Maintenance" in the May 1956 issue of INDUSTRY POWER. Since I am only an amateur enthusiast, I may be somewhat confused on circuitry, but I believe there are two errors in the power supply circuits in Figure 3, Page 43.

The circuit labelled a half-wave rectifier shows power output via a control grid, and I cannot locate a half-wave tube socket diagram which incorporates a grid connection.

In the same figure, I believe the so-called "pi" section filter should most properly be labelled a capacitive input filter, since it is my understanding that a "pi" section is more likely to be used in a radio frequency transmission line rather than in a low-frequency power application.

Dallas R. Cox
Rolling Mill
Ford Motor Company
Dearborn, Mich.

● *Author Seagrave appreciates your keen eye which caught the error in our May issue. Note the text, Page 44, which says "The cir-*

There's no danger—just mebbe once in a while a boiler blows up!

cuit will not be difficult to identify. Look for the rectifier tube with no control grid."

Although the terms "pi" section, "T" section, and "L" section are most often used to describe matching networks in audio- and radio-frequency circuits, the use of the Greek letter "pi" is not technically incorrect in this application, according to our author. It is useful to fix in one's mind, he adds, the configuration of the filter's components. The filter shown is definitely of the capacitive input type.

Loss prevention bulletin

Gentlemen:

In the May issue of INDUSTRY POWER, there is a very interesting article on Page 49, entitled "How they Start —Explosion, Flash, and Simple Combustion." In this article, reference is made to Loss Prevention Bulletin No. 36.10, "Properties of Flammable Liquids, Gases, and Solids." Will you please advise me where I may obtain copies of this bulletin?

J. G. Ford
Manager
Manufacturing Engineer Dept.
Transformer Division
Westinghouse Electric Corporation
Sharon, Pa.

• *Copies of "Loss Prevention Bulletin No. 36.10" may be obtained by writing to Factory Mutual Engineering Division, Publications Department, 1151 Boston-Providence Turnpike, Norwood, Mass. There is a nominal charge of 25¢ per copy.*

send in your

cartoon ideas

Ever run across situations in your plant that gave you a real chuckle? Share those situations with your fellow readers of INDUSTRY POWER. We will send you $5 for every cartoon idea accepted, $10 per finished cartoon sketch accepted. (Sketches must be in black ink on heavy white paper, about six inches by six inches square.)

Just two conditions apply: Cartoon ideas must pertain to the power services, and they must be in good taste. Otherwise, the field for your cartoon ideas is wide open. Send along your ideas and sketches to

H. A. Bergen, Editor
INDUSTRY POWER
Commercial Bank Building
St. Joseph, Michigan

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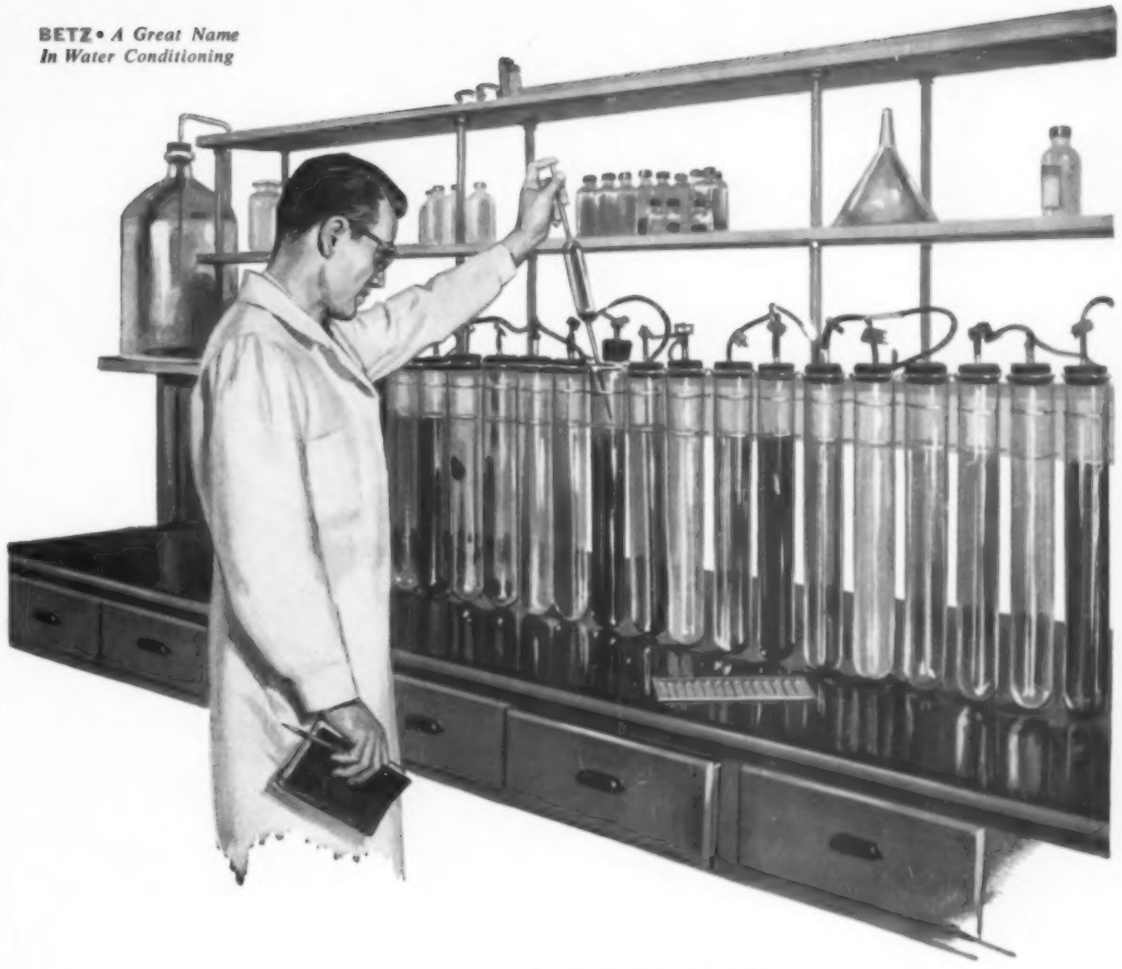

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. . . *first* to pioneer the use of effective antifoam agents for prevention of carryover.

. . . *first* to develop a practical method of silica removal from boiler feedwater.

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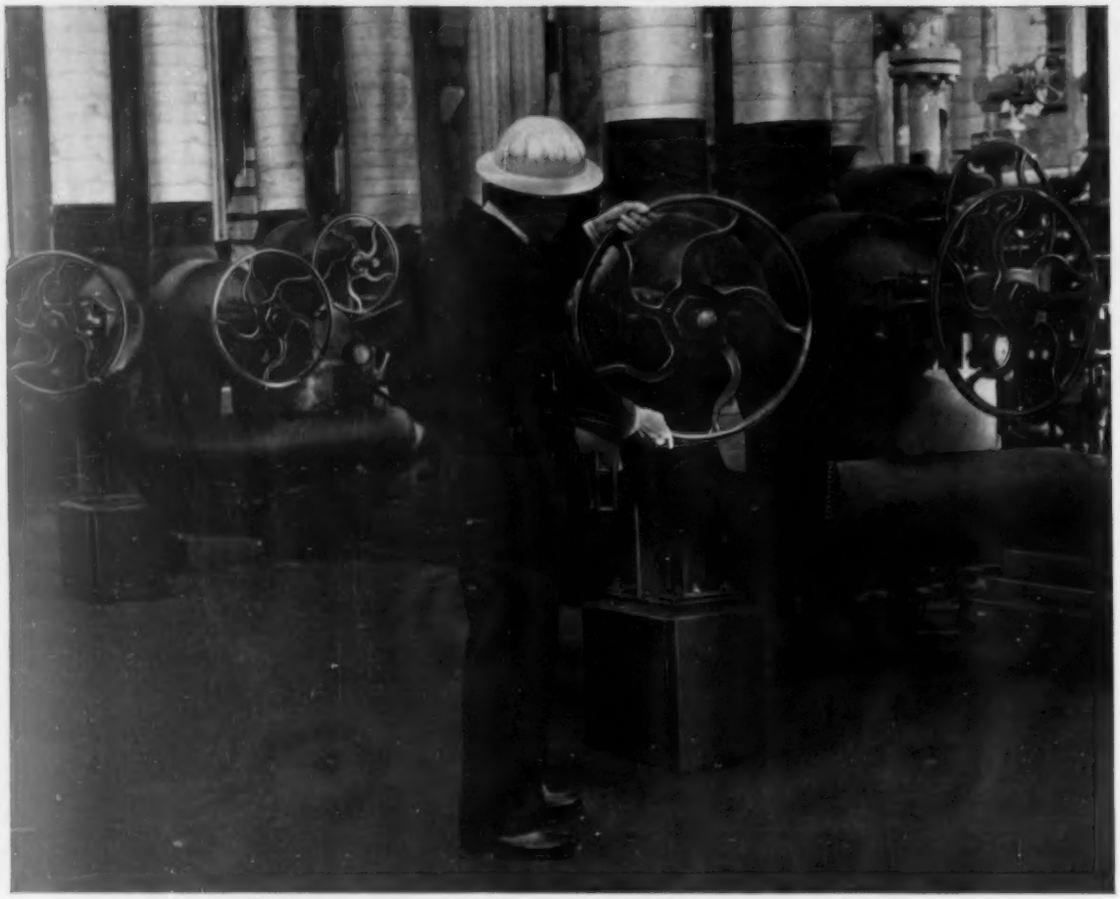

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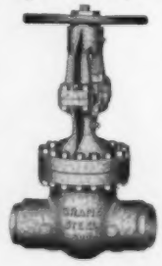

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Industry Power

Commercial Bank Building, Saint Joseph, Michigan

VOLUME 71 NO. 2 JULY 1956

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- Major articles are indexed on title page — see page 5.
- Advertisers are indexed alphabetically — see page 55.
- Advertisements are indexed by products in handy guide — see page 49.
- Important literature is indexed by products — see page 42.

this month's comment . . . .

Look Mom. . . no subscription price!!!

Yes, that's right . . . there's no subscription price to INDUSTRY POWER *if you are a "desired reader"*—that is, *if* you are responsible for an important phase of power services.

How can this be? Why?

Well, first let's look at a few facts of business magazine publishing:

1) A power magazine must serve *only* a highly specialized group of men . . . like you.
2) But you who are power men . . . limited to thousands among the millions of people in the United States . . . are scattered all over the country. And you're *hard men to get to.*
3) Moreover, many of you simply can't be reached a reasonable cost . . . so it's tremendously expensive to try to sell you a subscription . . . *and* too many of you important men do not subscribe no matter what efforts are made to sell you.

SO . . . it's not only easier, but actually *less expensive,* simply to "hand-pick" you who are important power men and deliver INDUSTRY POWER to you without demanding payment of subscription.

That way IP gets far better coverage of key power folks . . . and so it serves more desired readers . . . and so the advertising is more effective (an "effectiveness" proven by reader response).

For, you see, an industrial magazine lives from the advertising dollars it takes in . . . not from subscription dollars. In fact, most paid-subscription industrial magazines spend more on selling subscriptions than they get back in subscription dollars!!!!!!

Then why do some publishers keep on trying to sell subscriptions?

Well, there's an old postal law—passed way back in 1879, long before "controlled," "no-subscription-price" circulation methods were known—which still gives a low postage rate to paid-circulation magazines. Some publishers still feel this "postal subsidy" is necessary.

We differ . . . we believe it is more important to give greater service to more power men than it is to save on postage. (After all, it is effective advertising that pays the bills . . . not subscriptions. By serving more "desired readers," we give greater advertising values.)

Moreover . . . *no* subscription price within reason could possibly pay for any good industrial magazine. Actually to prepare, print, and mail a good industrial magazine costs $20.00 to $40.00 or more per year for each reader served. So, you see, a subscription price is no more than a token payment that qualifies some magazines for postal subsidy.

So . . . that's why

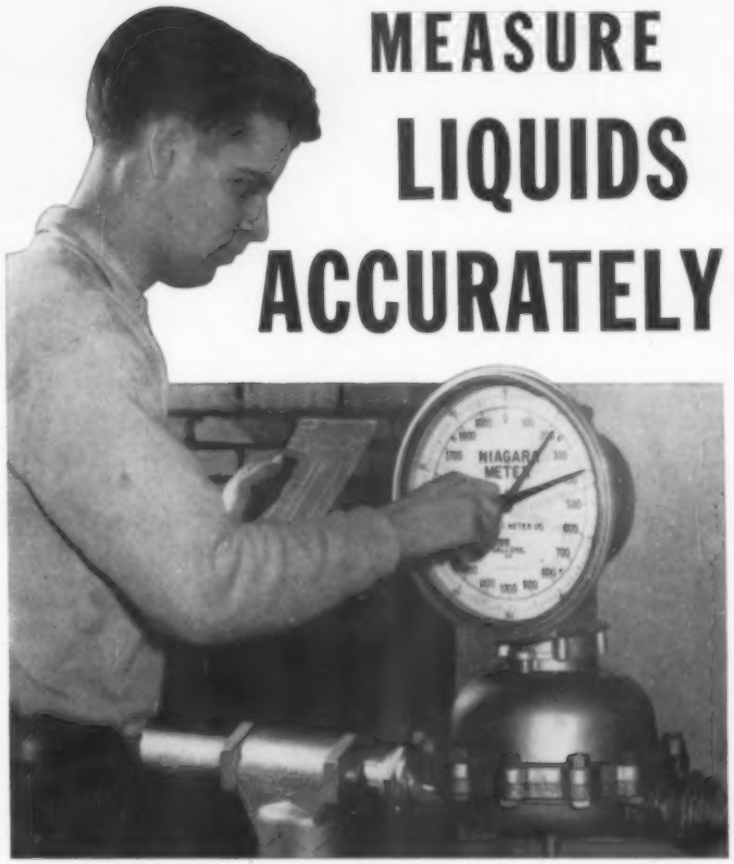
. . . you receive this magazine without subscription charge. Doesn't it make sense to do it the way more power people can be served? . . . and served better?

Russell L. Putman

Russell L. Putman, President
PUTMAN PUBLISHING COMPANY

Note: General or "mass" magazines do not have this problem of "hand-picking" special readers. They simply serve "people" as "people." So paid circulation methods are practicable for them.

* Because IP does render a public service, men outside the field served by IP may buy it at "$1.00 per copy" or "$10.00 the year." Such paid subscriptions are few in number . . . they are not included as "power" circulation on BPA audit reports.



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San Francisco's North Point sewage plant licks noise through

Reverberation Control

LYLE F. YERGES, President
Acoustical Materials Association
with R. W. De Moss, Assistant Editor

REMARKABLE IMPROVEMENTS in reducing noise levels are achieved by controlling the key factor — reverberation — with strategic location of sound-absorptive acoustical material — such as is done at San Francisco's North Point Sewage plant.

If you have enough imagination, you may be able to visualize a millenium in which all kinds of heavy machinery will run as quietly as a noiseless typewriter.

In the meantime, however, the industrial noise problem is still with us. Automatic screw machines, even at 85 db, are still too noisy for real comfort. A roomful of them will set up enough noise to be at least potentially damaging to personnel.

Some medical authorities believe that 85 to 90 db is the most noise that the average human system can endure over prolonged periods without lasting harm. The louder the noise, the more harm it can do. A level above 100 db can cause temporary deafness after an exposure of an hour or less. Levels of 130 db can cause actual physical pain, and 150 db can burst the eardrums.

Intensities of 150 db fortunately aren't encountered in most manufacturing plants. But levels of 100 to 130 db remain common. Most effective remedies are:

- Isolate the worst noisemakers where possible.
- Quiet working spaces with sound-absorptive acoustical material to eliminate reverberation.

Reverberation is what makes noise really noisy. Most machinery clatter and roar would be tolerable if it could be set up outdoors, in an open field. Sound traveling at 1120 ft/sec is quickly dispersed unless it encounters some solid obstacle that bounces it back as an echo.

Sound waves radiating from noisy machines indoors encounter such obstacles in every direction — floors, walls, ceilings, windows, skylights, and even machine surfaces themselves. These obstacles present hard, smooth surfaces — concrete, masonry, glass, wood, and metal — that reflect sound as a mirror reflects light. Up to 98.5 percent of the sound that strikes them bounces back into the room. Each wave continues to bounce and ricochet from surface to surface until its energy is exhausted. This prolongs and amplifies the original sound and adds an unpleasant *ringing* effect.

San Francisco's North Point plant licked noise problem with acoustical treatment of high, narrow walls.

cut noise 50 percent

Overall noise level in a noisy room can be reduced 50 percent or more by eliminating these reverberations. Indeed, an acoustically treated room often is found to be more comfortable than an untreated room with lower actual noise level. Aircraft plant experiences bear this out. In one case, noise level of 110 to 115 db existed in the drophammer room. Noise was incident to operation of four large power hammers and seven drophammers. Operators and foreman alike reported conditions unbearable when *any* equipment was in use.

Acoustical treatment lowered the room noise level by about 8 db. Noise level was still well above the damage risk level — but workers no longer complained about hammer *ring*. Workers were able to bear up without marked discomfort by using ear plugs. Interoffice calls now can be made from a sound-treated phone booth in the room — something that was previously impossible.

In a second aircraft plant, the propeller grinding room was the trouble spot. Noise level, with only four to six men grinding at their benches, was 100 to 102 db of the worst kind of din. Noise was so bad that after a stay of only 30 minutes, visitors left the room with loud ringing in the ears and temporary deafness that lasted for an hour or two afterward. Obviously, no one could remain at work for more than a few minutes at a time. Workers then had to step outside for relief.

Reverberations are well contained within operator's enclosure in some plants by acoustical curtains.

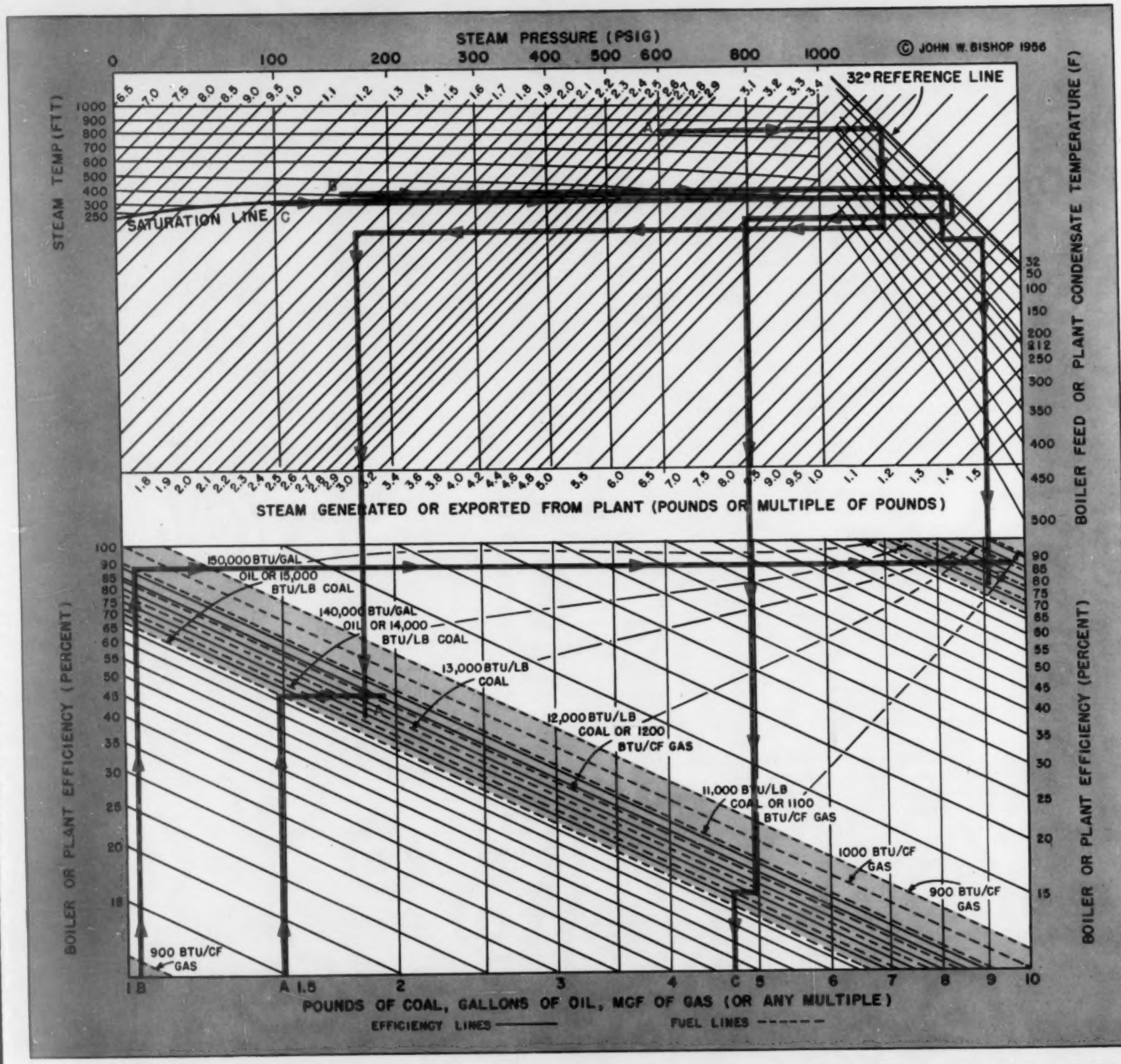
Acoustical treatment effected a dramatic change. As in the case of the drophammer room, actual noise level reduction was only 3 or 4 db. Nevertheless, 12 to 15 men now were able to work simultaneously in reasonable comfort.

logarithmic decibel

Since the decibel scale is a logarithmic function, a reduction of 3 or 4 db represents about a 50 percent reduction in intensity. But, the level still was above the damage risk criterion. It was not noise reduction but changed behavior of the sound that brought relief. The *ring* — reverberation — was then gone.

Another manufacturing plant attacked the grinder noise problem with a combination of isolation and absorption. Work benches were covered with an open-front, trunk-size box facing the operator. Box was lined with ordinary acoustical material. The

(continues on page 30)


STEAM PRESSURE (PSIG)
0
100
200
300
400
500
600
800
1000
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32° REFERENCE LINE
STEAM TEMP (FTT)
1000
900
800
700
600
500
400
300
250
SATURATION LINE
B
C
32
50
100
150
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212
250
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350
400
450
500
BOILER FEED OR PLANT CONDENSATE TEMPERATURE (F)
STEAM GENERATED OR EXPORTED FROM PLANT (POUNDS OR MULTIPLE OF POUNDS)
150,000 BTU/GAL OIL OR 15,000 BTU/LB COAL
140,000 BTU/GAL OIL OR 14,000 BTU/LB COAL
13,000 BTU/LB COAL
12,000 BTU/LB COAL OR 1200 BTU/CF GAS
11,000 BTU/LB COAL OR 1100 BTU/CF GAS
1000 BTU/CF GAS
900 BTU/CF GAS
900 BTU/CF GAS
BOILER OR PLANT EFFICIENCY (PERCENT)
BOILER OR PLANT EFFICIENCY (PERCENT)
100
90
85
80
75
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35
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1 B
A 1.5
2
3
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C 5
6
7
8
9
10
POUNDS OF COAL, GALLONS OF OIL, MCF OF GAS (OR ANY MULTIPLE)
EFFICIENCY LINES
FUEL LINES

Ever wonder if you are burning more fuel than your loads really demand? Use this chart to check power plant performance by computing . . . .

YOUR FUEL TARGETS

JOHN BISHOP
Mechanical Engineer
Power Generating Section
U S Navy Department, Bureau of Yards and Docks

DO YOU KNOW how much fuel you should burn today? How much *did* you burn? Do you have a fuel target? You should:

- Check actual boiler efficiencies against manufacturer's curves to detect losses from improper boiler operation or maintenance.
- Check *actual* against *expected* overall power plant efficiency (usually derived from boiler manufacturer's curves less expected losses from blowdown, sootblowing, plant radiation, venting, and miscellaneous losses). This will help to point out deficiencies in overall operation maintenance.
- Determine a *fuel target* for any given period of operation. Fuel target is the amount of fuel that would have been consumed if power plant efficiency had been what it should be. Comparison of this target against the amount actually consumed may be used to determine the dollar savings attainable by proper operation.

Chart quickly determines fuel targets. Steam pressure and temperature curves graphically establish enthalpy for the steam. Feedwater temperature curves (for boiler efficiency calculation) or return-makeup water temperature curves (for overall power plant calculation) establish net boiler (or power plant) unit heat input per pound of steam. Curves representing the amount of steam produced by the boilers (or exported from the power plant) convert these figures (Btu/lb) into total net heat added by the boiler or overall power plant. Fuel curves at bottom of chart establish heat content in the fuel burned. Efficiency curves establish the percent relationship between total heat added by the boiler (or power plant) with respect to the fuel as consumed.

Use of the chart for determination of boiler efficiency, power plant efficiency, and power plant fuel target is explained by these examples:

This chart is suitable for any size boiler firing any fuel, needs no steam tables or engineering data.

boiler efficiency determination

EXAMPLE: 16,800,000 pounds of steam are generated at 600 psig and 825 F, with average 350 F feedwater and burning 148,300 gallons of No. 6 fuel oil. To find average boiler efficiency for the period considered, follow the dotted line.

Enter top of chart at intersection of 600 psig pressure line and 825 F temperature line (marked "A") and proceed horizontally to *32° reference line.*

Proceed vertically to 350 F feedwater temperature line and then horizontally to 16,800,000 pounds of steam generated line (read as 1.68).

Extend vertically *(total heat added line)* into efficiency section of chart.

Enter bottom of chart (at point marked "A") with 148,300 gallons of No. 6 fuel oil consumed (read as 1.48) and proceed vertically to No. 6 fuel oil line (151,000 Btu/gal). Extend horizontal line to intersect vertical *Total Heat Added Line* already drawn.

Read intersection point as 82 percent actual boiler efficiency (marked "A").

overall power plant efficiency

EXAMPLE: 8,500,000 pounds of steam are exported from power plant at 150 psig, 400 F, with average 180 F condensate return. 10,320 M cu ft of 1100 Btu/cu ft gas are burned. To find the average overall power plant efficiency for the period considered, follow the dashed line.

Enter top of chart at intersection of 150 psig pressure and 400 F temperature lines (marked "B") and proceed horizontally to *32° reference line.*

Proceed vertically to 180 F plant condensate temperature line and then horizontally to 8,500,000 pounds of steam exported line (read as 8.5).

Extend vertical line into efficiency section of chart, *(total heat added line).*

Enter bottom of chart (at point marked "B") with 10,320 M cu ft of gas (read as 1.03) and proceed vertically to 1100 Btu/cu ft gas fuel line. Extend a horizontal line to intersect *Heat Added Line.* Read 80 percent actual power plant efficiency (marked "B").

overall fuel target determination

EXAMPLE: 4,400,000 lbs of saturated steam are exported from the power plant at 100 psig, with average 100 F condensate return. Fuel burned is 14,000 Btu/lb coal. For this loading, manufacturer's efficiency curves and other data indicate an expected power plant efficiency of 75 percent. To find fuel target, follow the dashed and dotted line.

Enter top of chart at intersection of 100 psig pressure and *saturation line* (marked "C") and proceed horizontally to *32° reference line.*

Proceed vertically to 100 F condensate temperature line and then horizontally to 4,400,000 pounds of steam exported line (read as 4.4).

Proceed vertically to 75 percent plant efficiency line and then horizontally to 14,000 Btu/lb coal line.

Drop vertically to fuel scale (at point marked "C") and read 470,000 lbs (235 tons) of coal, which is fuel target for the period considered.

If, for example, 290 tons of coal at an in-the-bunker cost of $8.50 had actually been consumed during this period, the loss in not meeting expected power plant efficiency of 75 percent would be $(290-235) (8.50) = $467.50 for the period under comparison.

To make the chart universally applicable for any boiler size or any time period, quantities of steam generated (or exported) and fuel consumed are given in digital form. They should be used and read like a conventional slide rule.

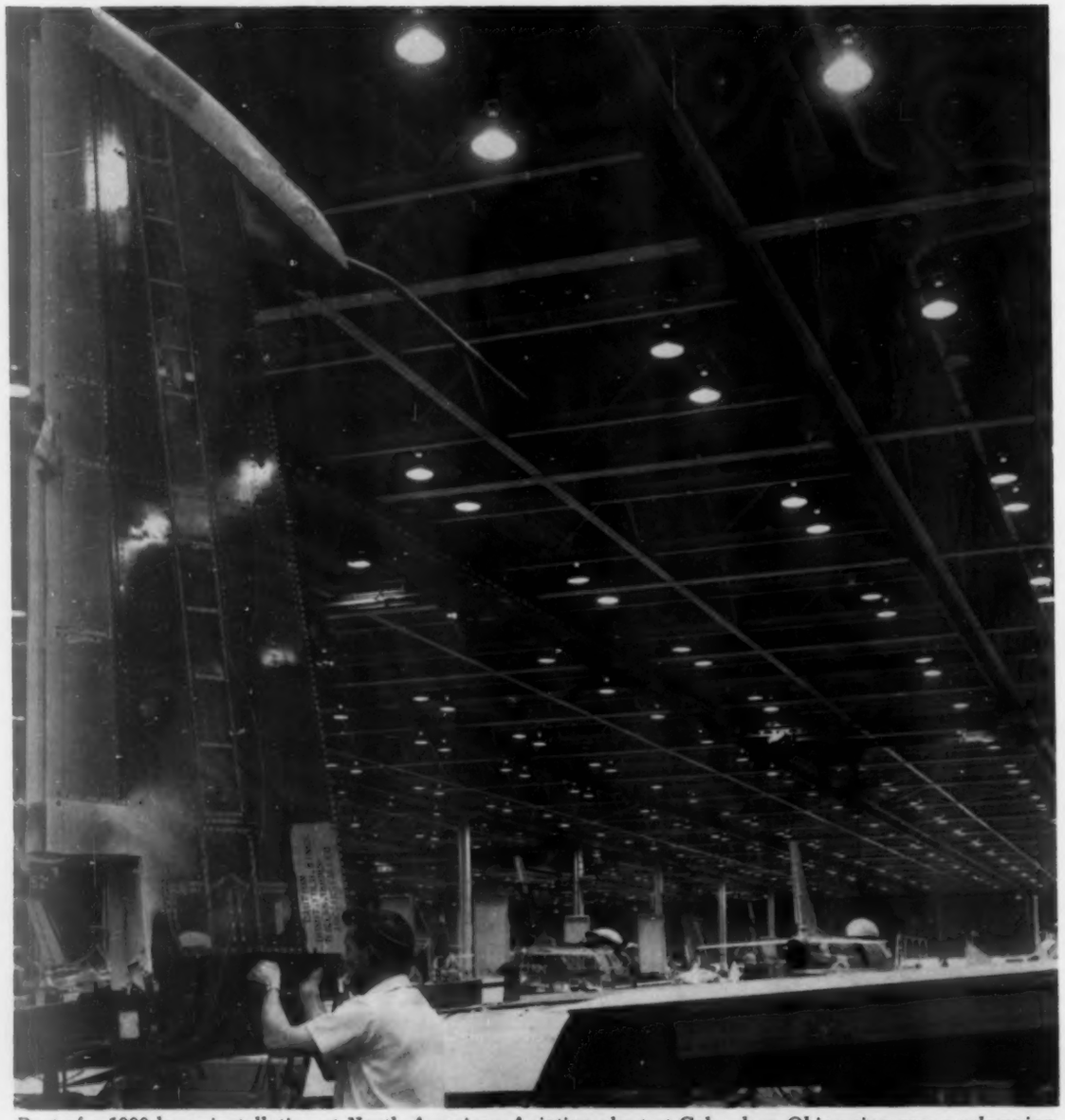
As an aid to determining the decimal point when reading the fuel target, remember that the amount of steam almost always will be between:

- 3 to 15 times the pounds-of-coal target,
- 30 to 140 times the gallons-of-oil target, or
- 200 to 900 times the M cu ft-of-gas target. ♦ ♦

Planned lighting system maintenance must be considered in the same category as machinery maintenance, because . . . .

Relamping Mercury's pays off, too

M. E. HASKINS, JR.
Lamp Division
Commercial Engineering Dept.
Westinghouse Electric Corporation



Part of a 1000-lamp installation at North American Aviation plant at Columbus, Ohio using group relamping.

WHY SPEND EXTRA MONEY for lighting maintenance just to keep from wasting money already spent? Some money however has to be spent. The question, then, is not one of spending money — but of how much to spend. The question can be resolved this way:

$ Spent + $ Wasted = Minimum

Most economic way to relamp is to minimize *direct* plus *indirect (wasted)* costs. This can be done by analyzing costs using statistical data on lamp performance. You can do it yourself.

Consider, for example, a lighting installation of 100 E-H1 mercury lamps. Tables I, II, and III give specific engineering preliminaries. Table IV (a composite of Tables I, II, and III) shows the specific conditions of our sample case (lines 4 to 14) as well as the calculations made. Figures show that group relamping between 7000 and 8000 hours will result in economies of $360 per year when compared to relamping only when lamps burn out. While calculations show the economics of various relamping schedules, final decision is made only after other factors are considered. Advantage of having actual dollar-and-cents values for total relamping costs helps in arriving at a factual decision.

Table V shows changes in total cost and optimum relamping cycle with variations in costs of lamps, labor, energy, and investment. It shows that in every case considered, group relamping is more economical than random relamping.

What is different about mercury lamps? From the maintenance point of view they cost more, have greater light depreciation, and have longer life than other types of lamps. This last item is not too well understood. Lamp manufacturers rate mercury lamps in terms of economic rather than mean life, as is done with incandescent and fluorescent lamps. Statistical data on quartz mercury lamps show that a 400-watt quartz mercury lamp should not be allowed to burn until it eventually fails. By this time, it may be producing as little as 10 percent of its initial

light output. Statistical data is not yet available on the newer, higher wattage mercury lamps. There is no reason to believe, however, that their life and rate of lumen depreciation will vary from that of 400-watt lamps.

Many good plans for systematic relamping die because steps for administration are not put into effect. These steps will vary for different plants, but there are four common roadblocks:

- Lack of manpower
- Improper equipment for group relamping
- Lack of a means of deciding when to start
- Fear of hidden administrative costs

In large plants, it is relatively simple to assign three or more men to the task of relamping (and cleaning fixtures). A lighting maintenance crew can be kept busy most of the year with group relamping or with cleaning fixtures a section at a time. Investment in equipment for easy access to lamps and fixtures pays off rapidly in such cases. A crew trained in modern methods can save labor compared to untrained men who just happen to be available. Knowledge of equipment also prevents future troubles.

Quick inspection of ballasts and wiring can be made by crew while lamps are being group replaced.

In small plants, it may pay to give lighting maintenance work to an independent contractor. Contractors can employ full-time specialists, provide night-and-day emergency service, purchase efficient access equipment, and even stock lamps and spare parts. Wisdom of contracting maintenance calls for evaluation of inplant maintenance costs (Table IV). Reduced responsibility and supervision is obtained by contracting the work. Better service is secured in exchange for a legitimate charge.

When to start—this is a roadblock sometimes harder to overcome than the first two. Plant managers are not often disposed to throw away *good* lamps —or *good* anything. There are ways of getting around the problem, depending on specific conditions. There is no problem if the hours each lamp has been used is known or can be closely approximated. Group relamp at the calculated time.

If only the exact number of burnouts is known, it is possible to estimate a good starting time for group relamping by keeping track of burnouts and referring to line 3 of Table I. This is accurate only for large numbers of lamps, however.

If neither the number of burning hours nor the exact number of burnouts is known, various methods are available to determine when to group relamp the whole installation. One of these, if no record has been kept of replacement lamps, is to mark all new lamps used to replace burnouts. When the number of marked lamps in use equals the number of replacements for casual burnouts per cycle, (line 3 of Table I) it is time to group relamp. Marked lamps are saved for replacing burnouts in the next cycle.

(continues on page 18)

TABLE I

DATA FOR GROUP RELAMPING 400-WATT QUARTZ MERCURY LAMPS

Group Relamping Cycle (Burning Hours)	5000	6000	7000	8000	9000	10,000	12,000	Random
1) Mean Lumen Depreciation of Installation*	0.15	0.17	0.19	0.21	0.23	0.25	0.28	0.35
2) Correction Factor for Cycle Length (Random Life)/(Group Life)**	2.4	2.0	1.7	1.5	1.3	1.2	1.0	1.0
3) Replacements (per hundred lamps) for Casual Burnouts‡	14	17	20	22	26	29	41	

* Includes improved new lamp light output used to replace casual burnouts between relamping cycles. If random life differs from 12,000 hours, the figure is no longer 0.35 but must be obtained from Fig. 2.

** Cost of a 6000-hour cycle is multiplied by 2 to compare with a 12,000 hour cycle. If random life differs from 12,000 hours, line 2 must be recalculated.

‡ Using new lamps to replace casual burnouts.

TABLE II

DATA TO CALCULATE GROUP RELAMPING CYCLES

4) Net lamp cost ($)	_____
5) Number of lamps in installation	_____
6) Average lamp life * (hours)	_____
7) Labor rate per hour, including overhead ($)	_____
8) Relamping time, random (minutes per lamp)	_____
9) Relamping time, group (minutes per lamp)	_____
10) Energy rate ($ per KWH)	_____
11) Watts per lamp (including ballast)	_____
12) Total cost of installation ** (fixtures, wiring, labor)	_____
13) Amortization period (in years)	_____
14) Burning hours per year	_____

* Use 12,000 hours if no private records of lamp life are available.

** To include insurance, taxes, and interest, multiply installation cost by 15 percent by number of years of installation life.

TABLE III

PROCEDURE FOR CALCULATING TOTAL RELAMPING COSTS

Random Relamping Cost

15)	Lamp cost for random relamping	(4) (5) *
16)	Labor cost for random relamping	(5) (7) (8)/60
17)	Wasted energy cost	(1) (5) (6) (10) (11)/1000
18)	Wasted installation cost	(1) (6) (12)/(13) (14)
19)	Total random relamping cost	(15 + 16 + 17 + 18)

Group Relamping Cost

Group Relamping Cycle (Burning Hours)		5000	6000	7000	8000	9000	10,000	12,000
20)	Lamp cost for group relamping	(2) (4) (5) *						
21)	Labor cost for group relamping	(2) (5 (7) (9)/60						
22)	Lamp cost for random relamping of burnouts	(2) (3) (4) (5)/100						
23)	Labor cost for random relamping of burnouts	(2) (3) (5) (7) (8)/6000						
24)	Wasted energy cost	(1) (5) (6) (10) (11)/1000						
25)	Wasted installation cost	(1) (6) (12)/(13) (14)						
26)	Total group relamping cost	(20 + 21 + 22 + 23 + 24 + 25)						

Comparison of Random and Group Relamping Cost

27)	Savings of group over random relamping	(19-26) *
28)	Savings per year	(14) (27)/6

* Numbers in parenthesis refer to lines in Tables I, II, and III

TABLE IV

WORK SHEET FOR CALCULATING TOTAL RELAMPING COSTS (USING NEW LAMPS FOR BURNOUTS)

Group Relamping Cycle		5000	6000	7000	8000	9000	10,000	Random
Basic Data	1	0.15	0.17	0.19	0.21	0.23	0.25	0.35
	2	2.4	2.0	1.7	1.5	1.3	1.2	1.0
From Table I	3	14	17	20	22	26	29	—
Specific Data for Sample Case	4	$12.00						
	5	100						
	6	12,000 hours						
	7	$3 per hour (including overhead charges)						
	8	40 minutes						
	9	8 minutes						
	10	$0.01/KWH						
	11	440 watts (including ballast)						
	12	$30,000 ($200 per lamp x 15% carrying charges for 10 years)						
	13	10 years						
From Table II	14	4000 hours						
Random Relamping Cost	15	$1,200						
	16	200						
	17	1,848						
	18	3,150						
From Table III	19	$6,398						
Group Relamping Cost	20	$2,880.00	$2,400.00	$2,058.00	$1,800.00	$1,599.00	$1,440.00	
	21	96.00	80.00	68.60	60.00	53.33	48.00	
	22	403.20	408.00	411.60	396.00	419.92	417.60	
	23	67.20	68.00	68.60	66.00	69.32	69.60	
	24	792.00	897.60	1,003.60	1,108.80	1,214.40	1,320.00	
	25	1,350.00	1,530.00	1,710.00	1,890.00	2 070.00	2,250.00	
From Table III	26	$5,588.40	$5,383.60	$5,320.40	$5,320.80	$5,425.97	$5,545.20	
Comparison of Group vs. Random Costs	27	$ 809.60	$1,014.40	$1,077.60	$1,077.20	$ 972.03	$ 852.80	
	28	269.87	338.13	359.20	359.07	324.01	284.27	

Replacements in subsequent cycles should be made with new lamps for greatest economy. (Table I).

Thorough study of relamping economics shows that using new lamps to replace casual failures between relamping cycles is more economical than saving the best of the group replaced for that purpose. This is due to the shorter life expectancy of group-replaced lamps (resulting in higher labor relamping cost) and their greater lumen depreciation (resulting in higher indirect relamping costs). The same study shows that in 10 cases out of 11, retirement plan that replaces individual lamps as they burn out or as they reach a certain age is not as economical as group relamping. (Furthermore, the extra record-keeping cost for any retirement plan was not added.) In the great majority of cases, it is possible to eliminate all relamping plans except group and random.

Fear of hidden administrative costs is probably the most difficult roadblock to surmount. But group relamping actually reduces administrative costs. This is often difficult to prove. This objection very often is only an expression of inertia to change. One way to overcome fear of hidden costs is to bring them out in the open.

lamp cost is variable

Lamp cost for relamping maintenance depends on lamp mortality, net costs of new lamps, purchasing cost and storage cost. Random relamping results in relatively small lamp orders with a reasonable storage time per lamp or in relatively large lamp orders with very long storage time per lamp. This increases either purchasing cost or storage cost, or both. With group relamping, large lamp orders can be scheduled for delivery at group relamping time. Storage space, investment in lamps, and casual losses can all be reduced substantially. Only a few lamps need be stocked for casual burnouts that occur between relamping cycles.

Labor cost depends on labor rate (including overhead charges) and time to replace lamp. Access to lamps greatly affects costs. Relamping time is often greatly decreased by group relamping because of great savings in set up time for scaffolding (or other access equipment). Investments for more efficient access to lamps should be justifiable in terms of lower relamping labor cost, reduction in labor for cleaning fixtures, or lower maintenance labor cost for other ceiling-mounted equipment.

Cost of energy wasted depends on mean lumen depreciation, energy rate, and watts per lamp (including ballast and line losses).

Cost of investment depends on mean lumen depreciation, total burning time, total investment for lighting, and amortization rate.

The only time requirement for group relamping not required by random relamping is keeping a record of the cycle length. This certainly can be handled with no measurable cost increase. Most lighting maintenance can be scheduled well in advance, instead of being done on a day-to-day routine.

Once a systematic relamping plan is put into effect, it cannot be forgotten. Almost any change in cost factors or in operating procedures can affect the most economic relamping cycle length. Cost factors must be checked periodically. If any item has changed, the computations must be rechecked. ♦ ♦

TABLE V — SAMPLE CASE COMPARISON

	Specific Costs					TOTAL RELAMPING COST (per lamp/12,000 hrs)		OPTIMUM RELAMPING CYCLE (burning hours)
Case	Lamp (net)	Random Labor (per lamp)	Group Labor (per lamp)	Energy (per KWH)	Investment (per lamp /12,000 hrs)	Group*	Random	Group*
A	12	$2.00	$0.40	0.01	$90	$53	$64	7500
B	18+	2.00	0.40	0.01	90	64	70	8000
C	6+	2.00	0.40	0.01	90	39	58	5000
D	12	10.00+	2.00+	0.01	90	58	72	8000–
E	12	0.40+	0.08+	0.01	90	52	62	7500–
F	12	4.00+	0.40	0.01	90	54	66	7500
G	12	2.00	2.04+	0.01	90	54	64	7500
H	12	2.00	0.40	0.02 +	90	63	82	6000+
I	12	2.00	0.40	0.005+	90	48	55	8000
J	12	2.00	0.40	0.01	45	44	48	8000

* Using new lamps to replace casual burnouts between relamping cycles.
\+ Variable in case

Radio Materials Corporation insures continuous production by

Outwitting Outages with dual-fuel diesel generator

Switchboard at left houses gauge and alarm panel for 360-hp dual-fuel engine driving 265-kw alternator.

TO GUARD AGAINST interruption in power supply, Radio Materials Corporation has installed a heavy-duty Fairbanks-Morse dual-fuel diesel driving a 265-kw alternator as primary source of power. Electric power failure during the firing process at their Attica, Ind. plant would result in scrapping at least a quarter-million ceramic condensers.

With many electrically powered machines and automatically controlled electric ovens, there are sudden drops and rises in demand for electric power. Load requirements fluctuate sharply, as much as 150 amperes. Company engineers report that the engine and governor take these swings easily.

Electric power to operate plant machinery was originally supplied by the local utility, but periodic service interruptions made it necessary for RMC to install an additional power source. In 1950, the company purchased a 250-hp high-speed light-duty diesel to help insure continuous supply. By 1953, plant expansion demanded increased power supply. Original engine was replaced with two 250-hp diesel-generator units. These light-duty engines supplied all power needs during working hours, but the electric company line was retained to supply power during weekends and off-shift periods.

In the summer of 1953, increasing production required still more power. RMC decided that a heavy-duty engine with greater horsepower would be best suited to supply the needed power capacity, to stand up dependably under the difficult variable load, and to provide production economy as a primary source of power.

Engine selected was a 6-cylinder, Model 31AD 8½ Fairbanks-Morse heavy-duty diesel with 8½-inch bore and 11½-inch stroke. Developing 360 hp at 514 rpm, the diesel directly drives an F-M Type TGZO alternator rated at 265 kw. This unit provides 3-phase, 4-wire, 120/208-volt current to operate plant machinery. It has handled up to 1000 amperes.

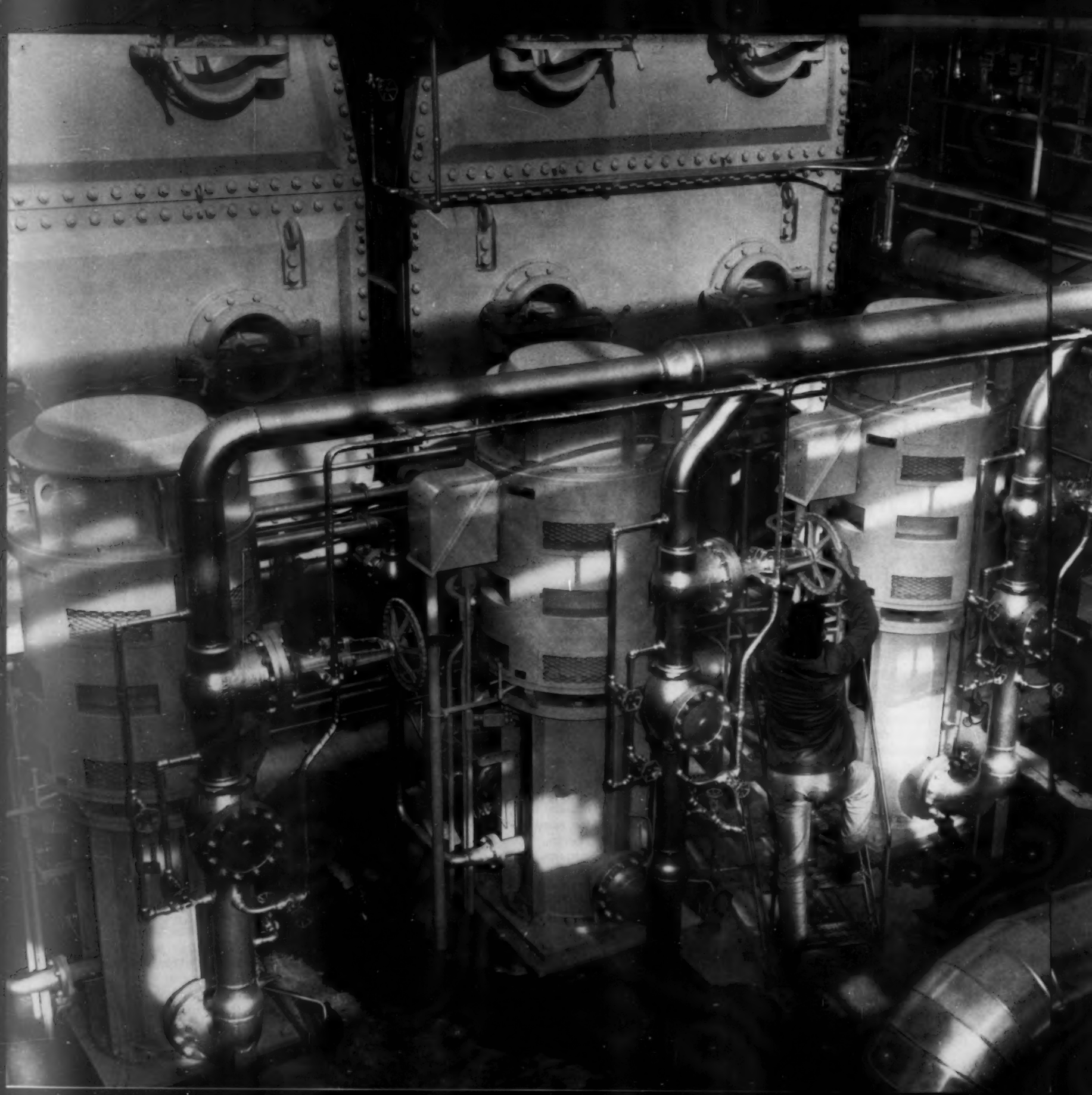
Two-cycle diesel was originally installed as an oil-burning engine, and was later converted to dual-fuel operation to take advantage of the cheaper natural gas piped into the Attica area. Gas reaches a regulator in the plant at 26 psig. Here it is reduced to 19 psig before entering the engine. Pilot oil for the diesel is brought in by truck and stored in an 8000-gallon underground tank. A motor-driven pump transfers fuel oil from storage to a 300-gallon day tank beneath the floor in front of the engine. From the small day tank, fuel is picked up by an engine-driven supply pump and delivered through filters to small-capacity injection pumps which handle the pilot oil. In the event of pressure loss or gas failure, the diesel switches automatically to oil operation without loss of load.

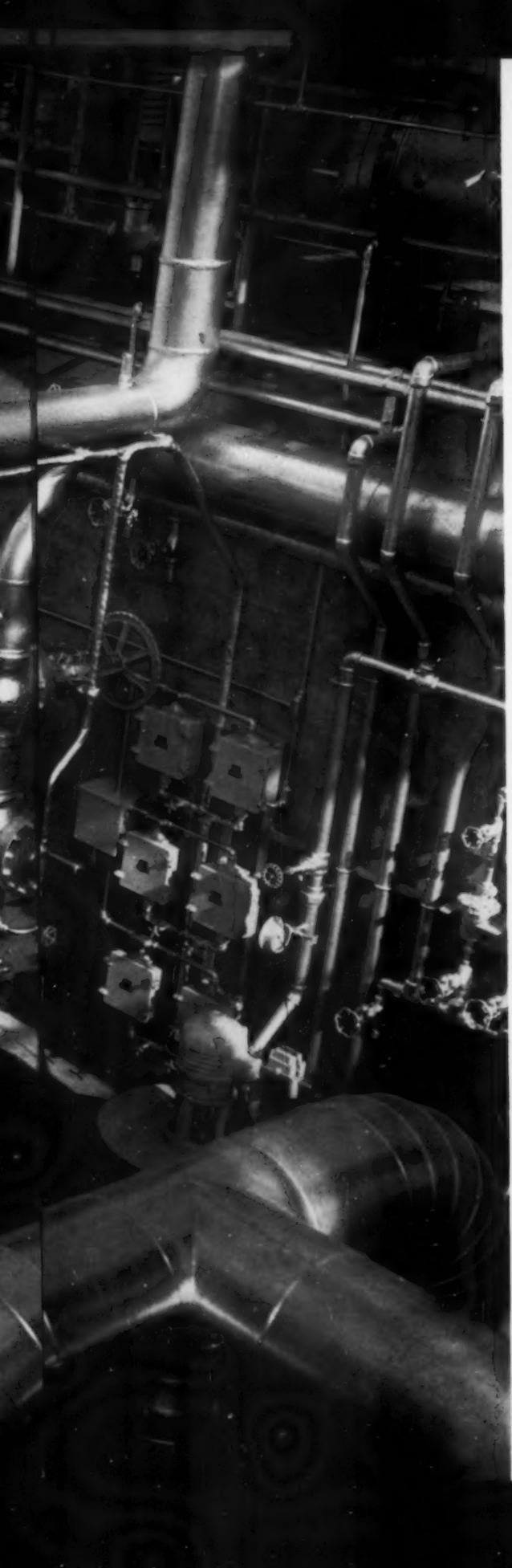
Detergent-type lubricating oil is circulated under pressure through the engine by an engine-driven pump. Included in the circuit are a shell-and-tube oil cooler and a three-element, full-flow strainer. Some oil is continuously bypassed from the lube system through a cartridge-type filter with disposable cellulose elements. There is also a motor-driven auxiliary lube pump.

An engine-driven centrifugal pump circulates soft water through the engine jackets and a heat exchanger. Raw water is put through the exchanger and a forced-draft cooling tower on the roof by a motor-driven centrifugal pump. An automatic thermostatic valve controls flow of raw water around the heat exchanger. Distilled water is used for makeup in the closed jacket-water circuit.

Scavenging air for the diesel is drawn from the

(continues on page 32)





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SQUEEZE out more power plant *EFFICIENCY*

JOHN M. DRABELLE
Registered Professional Engineer

with Donald Hartley
Managing Editor

BASED ON SOME 30 years firsthand experience with power plant betterment, your best bet for squeezing out the last few percent efficiency lies in the tough, but rewarding, approach via analysis of the heat cycle itself. All equipment in your power plant is there for the sole purpose of implementing the heat cycle. So it makes most sense to let improvement of the unit stem from study of the cycle as such. Equipment improvement should follow a "master plan" related to the heat cycle, rather than trying random equipment improvement.

For example, modern power plants use both closed and direct-contact heaters, depending upon size of the plant and the designers' conceptions. Usual arrangement has several shell and tube-type closed heaters with a direct-contact deaerating heater. Heat is also recovered from the steam used by the steam jet pumps. In larger units, generator heat losses are recovered by circulating condensate through the generator coolers on its way back to the boiler.

Mathematical equations for the performance and calculation of heating surfaces of closed-type heaters all assume that heater tubes are filled with flowing water and that the heater shell is completely filled with steam. This would give the lowest possible terminal difference. Small quantities of noncondensible gases come over with the steam, however. If they are not continuously removed, they will eventually blanket the heating surface. Heat transfer rate then will be reduced and terminal difference will increase. In fact, a tubular feedwater heater in which the noncondensible gases are not being properly removed can have its heat transfer rate reduced as much as 10 to 25 percent. When making this check it is most important that the load on the boiler be held constant, and then, after corrective measures are taken, that this condition be rechecked for conformity with the manufacturer's guarantee.

When checking performance of the unit, begin with the largest heat exchanger in the cycle—the surface condenser. Absolute pressure and temperature rise across this unit should be checked carefully with the manufacturer's guarantees. Amount of air handled by the steam jet air pumps or other air removing equipment must be cut to minimum.

For convenience, most steam jet air removal pumps are provided with an air measuring device. This usually takes the form of a Rotameter. Before using such a device, consult the manufacturer's instruction books very carefully as to operation and interpretation of readings. If the equipment is not provided with this device, a very effective but rough check can be made by merely closing the air line valves on the line between surface condenser and steam jet air apparatus. Leave the air jets in operation, of course, so no leakage will occur across these isolating valves. A vacuum drop of approximately one-half inch of mercury in thirty minutes usually means a good tight job — which incidentally, is not easy to obtain.

It is surprising how many valves on a modern unit are under vacuum, and how many manufacturers fail to pack valve stems properly. Valves should be checked carefully as the betterment work proceeds, watching the air meter to see if progress is being made. Bolts on all flange joints should be sledged up to help reduce the gas load on the steam jet air pumps to an absolute minimum.

Then, check the inner and after condensers in the two-stage steam jet air pump system. After the usual

(continues on page 33)

Ninemile Point Steam Electric Station has a Worthington main condenser on unit 3 — its newest unit.

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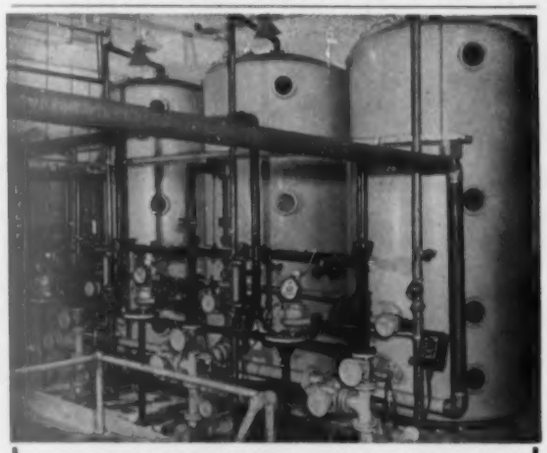

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How Magnavox's roof insulation Paid out in three months

D. W. KARGER
Chief Plant & Industrial Engineer
The Magnavox Company
with R. W. De Moss, Assistant Editor

YOUR PLANT need a new roof? Here's how Magnavox Company obtained extra insulation underneath its new roof at virtually no cost.

Magnavox's Fort Wayne plant was built in 1929 by local citizens trying to attract new industry. It is steel frame saw-tooth construction, originally with wood roof deck on top of the steel frame. Conventional multi-ply, builtup roofing was placed on this wood roof deck. Original roof was not bonded. A second layer of multi-ply roofing was laid on the original roof after 10 years. This second layer of roofing was not of a quality to warrant bonding by the roofing company. In fact, laying one coat on top of another does not produce a good roof. The net result is that this roof failed. Failure was due to the wood deck warping under the roofing as well as to failure of the roofing material itself.

Program to reroof the worst sections was started in 1952 as part of a long-range maintenance program. At that time, consideration was given to adding insulation under the roof. First step in installing this insulation would have been to tear off the old roof. Uneven portions of the deck then would be nailed down. Insulation would be laid on the wood deck. Finally, multi-ply roofing would have been put on top of the insulation. This was the conventional approach and was recommended by nationally known roofing companies. We were seeking a quality roof

Wood roof warping, with expansion and contraction of roofing layers, led to this cracking and roof failure. Laying insulation on old roof, with new roof above it, eliminated dirt and dust falling into plant beneath.

Finished roof, with insulating material applied over the old roof, gives smooth, bonded roof at minimun cost. Estimated savings over first three months have paid for cost of insulation. Roof has a 20-year surety bond.

that would permit the roofing company to extend a 20-year bond. When all factors in the plant building were evaluated, however, payout for this insulation (based on cutting down heat loss) would have taken more than 20 years.

Roofing companies would not put a third layer of multi-ply roofing over the existing roof and give a bond to cover the new roofing material. Based upon the above facts, a portion of our plant was reroofed by removing the old roofing material, nailing down the deck, and laying a new roof (without insulation) with 20-year bond.

installation a problem

In 1954, another section of our plant required reroofing. This roof covered an area housing precision electronic assembly operations. Removing old roofing material and nailing down loose boards on the wood deck would cause dust and dirt to settle over the assembly area. In addition, there would be danger of water entering through unprotected areas during roofing operations. Serious consideration was given to protecting the assembly area by stretching tarpaulins. This would only afford partial protection at best. Consideration was again given to leaving the old roof in place. Roofing companies again stated that they would not extend a bond unless the old roof was removed.

Investigations were conducted with the roofing companies as to why removal of the old roof was necessary. The problem resolved into three components:

- Sealing the new multi-ply roofing material to the old roof would not result in complete freedom of "action." Expansion and contraction of old layers of roofing coupled with that of the new roof would cause working and aging faster than if the new roofing were laid on a good wood deck.
- Air bubbles forming between the old roof sections plus additional ones forming between old and new roof would contribute to ultimate failure of a new roof.
- Tearing off old roof would permit eliminating unevenness in the wood deck caused by warped boards.

As a solution to the problem, consideration was given to laying insulation material directly on the old roof. New roofing would then be laid on the insulation material. Roofing companies indicated that such a roof could be bonded.

quoted two ways

Quotations were then secured covering roof sections that needed repair. Quotations were requested for two procedures: first, removing old roofing, repairing wood deck, and laying a new roof; second, applying treated roof insulation (1-inch thick) over the existing area and then laying a 20-year asbestos builtup roof on the insulation. In each case, four layers of 15-pound asbestos felt would be applied in hot asphalt over the roof insulation, or the wood deck.

Cost comparison between the two methods is shown below. Comparison excludes the intangible factor involving water and dirt damage possible with the conventional method.

CASE I — Reroofing approximately 52,400 sq ft in accordance with conventional method of removing old roof, repairing wood deck, and then laying a new roofing layer. (This excludes cost of protecting the plant from dislodged dust and dirt.) $11,120.00

Estimated labor cost to erect protective tarpaulins and covers. (This would require overtime wages due to work normally in progress in the area on the day shift. Clean up after moving from area to area would also be at overtime rate.) $3500.00

GRAND TOTAL CONVENTIONAL METHOD: $14,620.00

CASE II — Reroofing cost for 52,400 sq ft by laying insulating board over the old roof to provide a new acceptable roof deck. $15,000.00

Difference in cost that must be recovered by reduced heat loss in winter. $380.00

Neglecting possible dust, dirt, and water damage, the 1-inch insulation would pay for the difference in cost in approximately 3 months. This is based entirely on reducing heat loss during winter season. This computation was based on the number of degree-days where heat loss would occur. Degree-day information was obtained from the U. S. Weather Bureau.

savings calculated

BASIC DATA:

- Heating cost based on current steam cost is $0.00091 per 1000 Btu.
- Number of degree days below 65 F to be normally expected in our area is 6232.
- Heat transmission or heat loss based on handbook data and that supplied by the roofing company assuming still air inside and 15 mph wind outside.

a) Conventional roof (2-inch wood sheathing and one roofing coat): 0.32 Btu/hr/sq ft/degree F temp diff air to air.

b) Insulated roof (2-inch wood sheathing, 1-inch insulation, 3 roof coats): 0.10 Btu/hr/sq ft/ degree F temp diff air to air.

Area of roof being considered 52,400 sq ft.

COMPUTATION:

Conventional roof:

Btu loss over normal heating season=

$52{,}400 \times 6232 \times 0.32 \times 24 = 2{,}483{,}956{,}224$ Btu.

Cost of heat loss per season (year) =

$$\frac{2{,}483{,}956{,}224}{1000} \times 0.00091 = \$2260.40$$

Insulated Roof:

Btu loss over normal heating season =

$52{,}400 \times 6232 \times 0.10 \times 24 = 78{,}736{,}321$ Btu.

(continues on page 30)

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SIMPLE TWO-COIL transformer (Fig. 1) consists of a *primary* (to which power is supplied) and a *secondary* (to which a load is connected) mounted upon a core of iron or steel laminations. Usual functions of the transformer are to change voltage and current in the secondary as compared with the primary, and to isolate primary coils and connecting lines from the secondary coils and connecting lines. A single-coil transformer is possible, however, in which this isolating function is absent.

Ratio V_p: V_s is closely equal to the ratio of turns of wire in the primary winding to turns of wire in the secondary winding. Ratio I_p: I_s is very nearly the inverse of this turns ratio. Therefore, the product $V_p I_p$ may be, for practical purposes, considered equal to the product $V_s I_s$.

Actually, the induced voltages are proportional to the turns. These differ from the terminal voltages by the relatively small impedance drops in the windings due to the resistance and reactance present in the primary and secondary windings. At no-load, proportionality between terminal voltages and turns ratio is very closely equal because there is no impedance drop in the secondary and almost none in the primary winding. For no-load conditions, therefore, we may consider that

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p} \qquad (1)$$

from which

$$N_p I_p = N_s I_s \qquad (2)$$

where N = number of turns in coil.

Induced electromotive force in a transformer is dependent upon system frequency, core flux, and number of turns. With a sine wave of flux variation assumed, a sine wave of voltage will be induced that has an effective value

$$E = 4.44 f N \phi_m \times 10^{-8} \text{ volts} \qquad (3)$$

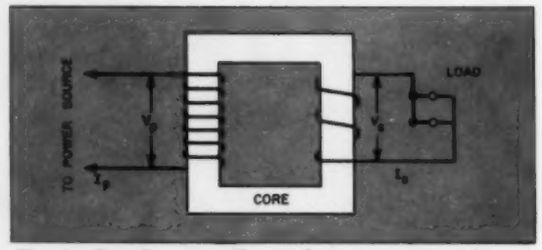

Fig. 1—Simple two-coil transformer consists of a primary and a secondary winding on a laminated core.

where E = effective induced voltage
f = frequency, in cps
N = turns in winding
ϕ_m = maximum flux density, maxwells per unit area

This induced voltage lags 90 electrical degrees behind the magnetic flux wave, placing it in opposition to the applied voltage. Secondary coil currents, therefore, set up magnetic flux in opposition to the flux set up by the primary coil currents, providing a control function governing the primary current to meet the needs of the secondary output or load.

When load is supplied by a transformer, assuming constant voltage applied to the primary terminals, IR and IX voltage drops cause secondary terminal voltage to be reduced to a somewhat lower value than under no-load conditions. If the secondary voltage is to be held constant, conversely, voltage applied to the primary terminals must be increased under conditions of load to compensate for the resistance and reactance drops. Percentage rise in secondary voltage as load decreases from rated value to zero is called the *voltage regulation*. Except on small transformers of less than 10 kva, regulation is unlikely to exceed 2 percent.

Since there are no moving parts in a transformer, there is no friction or windage loss. There are core losses however — eddy-current and hysteresis — that are largely independent of load, plus copper losses that vary as the square of the current.

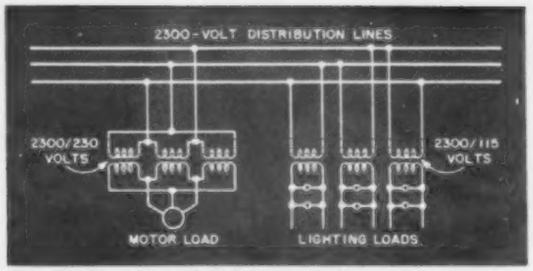

Fig. 2—Usual single-phase transformer connections to 3-phase service lines for motor and lighting loads.

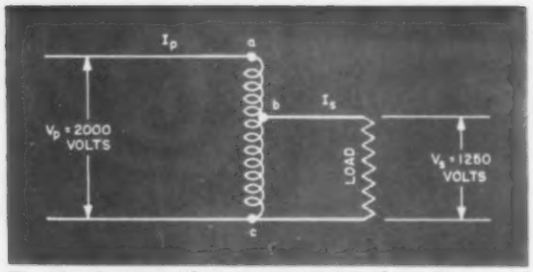

Fig. 4—Autotransformers use a single coil, part of which carries both primary and secondary currents.

Efficiency of transformers, therefore, is high compared with motors and generators. It usually equals 95 percent or better for smaller power transformers, and attains values of 99 percent or slightly higher in very large substation transformers.

transformer connections vary

Most transformers reduce voltage from distribution value to the lower utilization values. Such transformers usually have two low-voltage coils, which may be connected series or parallel, plus a single high-voltage coil having one or two "ratio taps" brought out for boosting secondary voltage to rated value where primary may be below rated value (as at the end of long lines).

Single-phase service requiring a single transformer is normally supplied from 3-phase through single transformers distributed among the three phases as shown in Fig. 2 (where the service is 3-wire or with single-phase primaries each connected between one line and neutral where the service is 4-wire. Three-phase motor loads are commonly supplied through transformers connected delta-delta as shown. Open-delta connection, Fig. 3, may be used for reduced load as a temporary expedient when one leg in a bank of closed-delta transformers is being repaired or replaced.

open delta economical

Open delta is an economical way of supplying 3-phase load that is expected to grow and later require a full bank connected closed-delta. When the load demand grows to a point that justifies addition, a gain of 73 percent in load capacity is achieved by adding the third transformer.

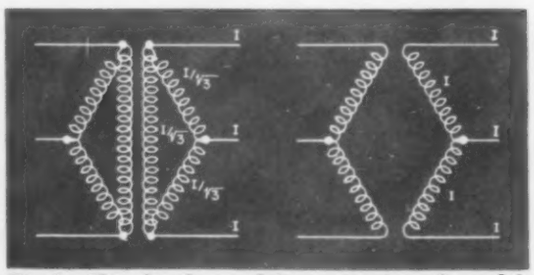

Fig. 3—Closed and open delta connections. Open delta system may be changed to closed as load grows.

Large substation transformers may be connected in any of the four possible combinations of star and delta. To lower the voltage applied to the transformer coils (thereby reducing strain on the insulation), however, they are usually connected delta-star for stepping up voltage at the source end to transmission-line value or star-delta for stepping it down at the load end of the line. High-capacity transformation is usually done with a 3-phase transformer, having three sets of primary and secondary coils mounted upon a single core and enclosed in a single case. Relatively low-capacity transformation is generally done with three single-phase units.

Autotransformers make use of a single coil, part of which serves as a common path for primary and secondary currents, Fig. 4. It may be used either for step-up or stepdown service. Because the primary and secondary currents traverse a common section of coil in opposite directions, autotransformers require less coil copper for transforming a given kva load than does the 2-coil type of transformer.

polyphase induction motors

Induction motors, generally speaking, are the simplest and most ruggedly built electric motors. They find extensive use in industry for applications where their operating characteristics are suitable. Their operation is similar to a transformer's in that there is no electrical connection between the stator (or primary) and the rotor (or secondary). Currents in the rotor circuits are due to voltages induced in the rotor conductors via a magnetic flux field. With a single-phase winding on the stator, torques produced in the two halves of the rotor would oppose each other and the motor would not be self-starting. But with three sets of coil windings — as in 3-phase motors — a revolving flux field is produced that cuts across the rotor conductors and induces voltages in them. This resultant field is brought about through the orderly succession of current variations in the 3-phase windings — sine-wave currents 120 electrical degrees apart in time;

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TABLE I

Stator Poles	Synchronous Speed 25 cps	60 cps
2	1500	3600
4	750	1800
6	500	1200
8	375	900
10	300	720

magnetic flux set up in the rotor by the phase windings of the stator does not rotate, but the resultant is that of a flux field having uniform strength and revolving synchronously with the frequency of the supply circuit.

Synchronous speed at which the revolving resultant field rotates depends on the stator supply frequency and on the number of poles per phase into which the stator windings are divided. Table I gives the synchronous speed in rpm for various pole-windings at frequencies of 25 and 60 cps.

Synchronous speed represents the upper limit of rotor speed, at which torque becomes zero. Actual speed drops below synchronous speed sufficiently for a balance to be effected between developed torque, torque losses in the rotor, and torque necessary for driving the load.

induction motor types

There are two principal types of polyphase induction motors: squirrel-cage and wound-rotor. Stator construction is the same for each, but rotor construction differs markedly.

In the squirrel-cage type, the rotor has (in lieu of coils) heavy copper, brass, or aluminum bars thrust through slots in a core of magnetic material. These bars are joined at their ends by short-circuiting rings of low-resistance metal. Rotor voltages being low, insulation requirements are easily met. Slots and bars are usually given a slight skew with respect to the shaft.

In the wound-rotor type, the rotor has a winding of insulated coils in slots and connected as a 3-phase, star-connected winding. Outer ends of the three sets of rotor coils terminate at slip-rings. Brushes connect the slip rings to a set of three variable resistors, connected in star, for symmetrical variation of resistance in series with the three rotor phase windings. This resistance variation is usually achieved through drum-type controllers. First notch inserts full resistance in series with the rotor phase windings. Final notch eliminates external rotor resistance by short-circuiting rotor leads. Starting, stopping, and reversal of the motor

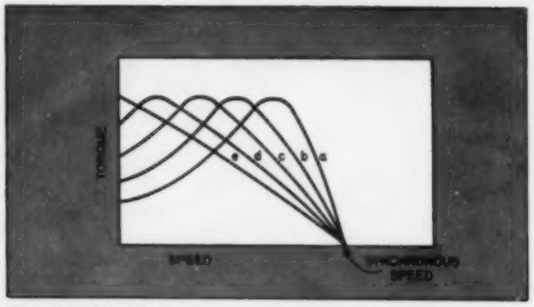

Fig. 5—Speed-torque curves for squirrel-cage motor showing effects of various values of rotor resistance.

cannot be effected by this controller unless two of the stator leads are brought to the controller and provided with suitable contacts there.

motor characteristics

At standstill, frequency of the rotor volts and amperes is the same as that of the power supplied to the stator. As the rotor speed rises, however, its conductors gain upon the revolving field, which is traveling at synchronous speed. Frequency of the induced rotor voltages and currents diminishes, and would reach zero if the rotor ever caught up with the revolving stator field. Frequency in the rotor circuit is therefore proportional to *slip*, or

$$f_r = sf$$

where f_r = rotor frequency
s = slip of the rotor below synchronous speed, in percent
f = supply-line frequency.

Due to the variation in rotor-circuit frequency between no-load and rated-load, rotor reactance varies proportionally — resulting in low rotor power factor at standstill, or at the instant of starting. This causes the induction motor to have relatively low starting torque unless rotor power factor is improved by adding resistance at starting (as is done in the wound-rotor type). Resistance added to the rotor of the squirrel-cage motor would be, of necessity, permanent. This would, under load conditions, adversely affect its speed regulation and efficiency. Referring to Fig. 5, Curve a represents the torque-speed curve of a standard squirrel-cage motor. Curves b, c, d, and e, show the effect of adding resistance to the rotor circuit, as in the wound-rotor motor. Beside the advantage of a fair amount of speed control afforded by the wound-rotor motor, the *maximum* torque point may be brought to zero speed, thus giving this motor a noteworthy advantage in starting and accelerating under heavy loads.

Squirrel-cage motors have good speed regulation, but no speed control. Wound-rotor motors have fair speed control at the expense of speed regulation since speed variation with load change is greater

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Associate Architect: John B. Peterkin.
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Architects: Leon and Lionel Levy, with Aymar Embury II, Otto Eggers of Eggers & Higgins, and John B. Peterkin, as a consulting and advisory committee.
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Higher voltage distribution, with dry-type transformers at load centers, which we have been advocating for years, is now recognized as the most efficient and economical method of interior electrical distribution. It has been adopted for the Socony Mobil Building and the new Coliseum in New York City.

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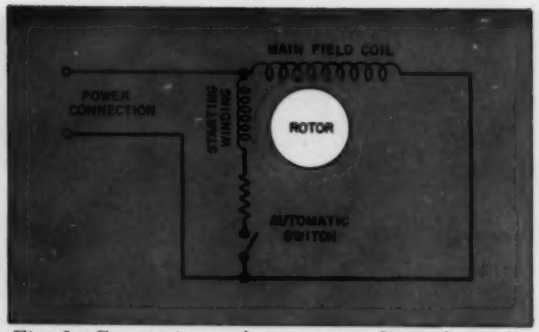

Fig. 6—Connections of motor windings for split-phase starting, showing how extra winding is used.

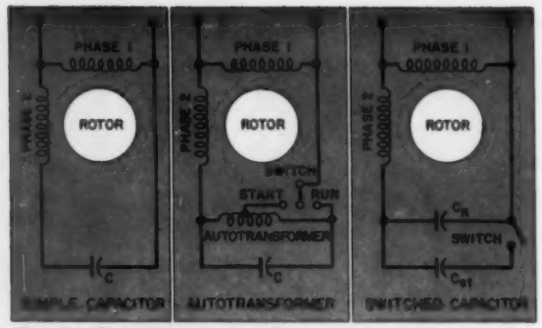

Fig. 7—Capacitor motors have a double set of windings and suitable series-connected capacitors.

with resistance added to the rotor circuit than it is without it.

Secondary results of reduced rotor power factor at starting is large starting currents drawn from the line by the squirrel-cage motor. These large starting currents, in many cases, require a starting compensator for reducing the voltage applied to the stator during starting and acceleration. Reduction of voltage for starting, however, has disadvantage of reducing the load the motor is capable of starting in some applications, since starting torque is closely proportional to the *square* of the applied voltage.

single-phase motors

Stator of single-phase induction motors may be wound for any number of poles, thus determining its speed as in the polyphase motor. Rotor, likewise may be of the squirrel-cage type or may be supplied with a winding having as many poles as the stator.

Essential feature of the single-phase induction motor is its lack of a revolving resultant flux field, and its resulting inability to start unless provided with an extra winding or other device for producing a net torque in a given direction.

Split-phase type motor has an extra winding, (Fig. 6) similar to that of a 2-phase motor, in which current is thrown out of phase with the current in the main winding by added resistance. This provides a rotating resultant field, though not one of constant value.

Inserting a capacitor in an auxiliary winding causes its current to lead that of the main winding by 90 electrical degrees, thus producing a uniform resultant field, as in the 2-phase motor. This is the *capacitor-start* motors. Both split-phase and capacitor-start motors have a centrifugal device for disconnecting the starting winding just before full speed is attained.

Another starting method, known as *repulsion start*, requires a commutator and brushes. Brushes short-circuit and carry current during the starting period. They automatically lift from the commutator and the commutator is short-circuited when the motor has reached a preset speed.

Capacitor motors have a double set of windings and capacitors of suitable ratings connected permanently in series with the main windings to give improved operating characteristics under load as well as to provide suitable starting torques. For best results, though, a different value of capacitance is required for starting than for running conditions. Two ways in which these requirements may be satisfied are shown in Fig. 7.

A single phase *series motor* — varying in some design details but with armature and field windings in series — has about the same operating characteristics as the series dc motor: high starting torque with reasonably good speed control but poor speed regulation, including excessive speed at zero load. This motor may be designed to operate satisfactorily from either dc or ac supply. Then it becomes a universal motor.

shaded poles

Shaded-pole motors are built with salient field poles. A portion of each pole is enclosed by a copper strap or *shading* coil, which acts as a short-circuited transformer secondary and shifts the phase of the flux in this section of the pole with reference to that in the unshaded portion. Main advantage is relatively low manufacturing cost. Shaded-pole motors have weak starting torque and find application only in quite small capacities. Ac generators may be designed with stationary field poles and rotating armatures — comparable in this respect to dc generators. Stationary-armature-rotating-field design, however, has become accepted practice for all but very small, low-voltage machines. Such design has advantages in having the relatively high-voltage armature windings and terminals insulated to a higher degree than would be possible with slip-rings and brushes.

Steam turbines operate most efficiently at high speeds, so their direct-connected generators are usually designed for two (or at most four) poles — giving speeds of 3600 (or 1800) rpm for 60-cps power. Most efficient speed of water turbines varies greatly with type and operating head, but they usu-

ally operate at slower speeds. Their generators, therefore, have a larger number of poles for a given frequency than have generators driven by steam turbines.

Dc for field poles of ac generators may be provided by small dc generators mechanically connected as an extension of the main turbogenerator shaft or by separate motor-driven dc generators, or *exciters*.

synchronous motors

Theoretically, ac generators and synchronous motors are identical except for direction of power flow. But synchronous motors usually differ in some features of their design that they may be better adapted to their work. Synchronous motors, for example, usually have salient field poles while alternators may have either salient or nonsalient poles. Synchronous motors have damper windings in their pole faces as a safeguard against rotor oscillation or *hunting* and as means of starting and getting up to synchronizing speed.

Synchronous motors operate only at synchronous speed, in step with the frequency of the supply. Synchronous speed depends upon frequency of the supply circuit and the number of motor poles, as in the generator. Synchronous motors are not inherently self-starting but must be brought up to speed and synchronized. Once in operation they maintain speed exactly in step with the supply—which means constant speed for all loads within range if the frequency of the supplied power is constant. Like the generator, they must have an auxiliary dc power source for the field circuit.

Assuming a synchronous motor brought up to synchronous speed, conditions after load is applied are represented in Fig. 8. Changes in mechanical load put upon the motor shaft cause momentary shifts in position of the rotor with respect to the stator flux field, as indicated by the *torque angle* α. But no change in rpm occurs. V_R is the resultant of the applied voltage V_t and the counter electromotive force E_b. V_R is the voltage that controls current I. There is a definite maximum torque load, however, beyond which the motor will pull out of synchronism and stop.

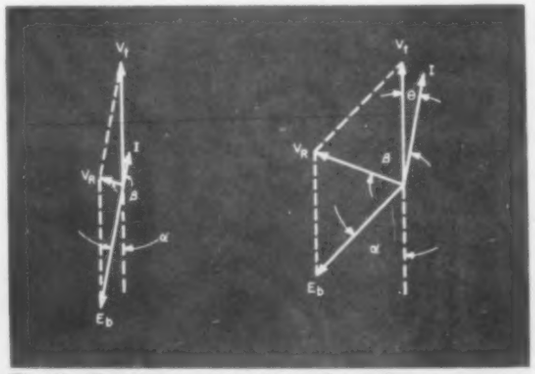

Fig. 8—Vector representation of synchronous-motor action after load is applied. No rpm change occurs.

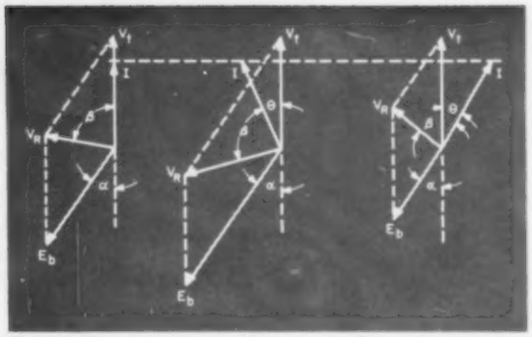

Fig. 9—Vector representation of effect of excitation on synchronous motor power factor. β is constant.

An outstanding characteristic of the synchronous motor other than its perfect speed regulation, is its adjustability as to power factor — being, in effect, a variable-power-factor motor. This feature is of little value as far as the motor itself is concerned. It is sometimes of considerable importance in improving voltage regulation and reducing power line losses. Here, the synchronous motor is operated at leading power factor to neutralize effects of lagging power factors at which other types of electrical equipment, such as induction motors, inherently operate.

Fig. 9 represents a condition wherein load and excitation are such that the current is in phase with the applied voltage V_t, the counter electromotive force. E_b is approximately equal, but not opposite, to the applied voltage V_t. (Increasing dc field current shifts the position of the resultant voltage V_R forward.) This, in turn, causes current I to *lead* applied voltage V_t. Likewise, decreasing field current shifts resultant voltage in the other direction, causing the current I to *lag* voltage V_t. Changes in field current, of course, directly affect the value of the generated or counter electromotive force E_b. Angle β is here considered a constant, being dependent upon the impedance of the circuit through which the current flows. ♦♦

Obligations of professionals

ENGINEERING EDUCATION has reached a point where students will be well served if they have a formal course of some kind which introduces them to codes of practice and the general obligations resting on professionals, according to Nathan W. Dougherty, Dean of the College of Engineering, University of Tennessee. At the recent national convention of the American Society of Civil Engineers, he urged the need for depth of study rather than concentration on breadth.

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Reverberation control

. . . starts on page 12

front was partly covered with an adjustable clear, plastic window. This reduced overall noise by 12 db at the operator's ears.

A comparable acoustical cover effected a 10 db noise reduction in a riveting hammer operation.

Some machinery can be walled off behind an acoustical barrier — in a soundtight room or compartment — with controls on the quiet side of the partition.

Where it is not feasible to acoustically wall off machines from men, the same result is achieved by erecting isolation booths for the men amid noisy surroundings. Prefabricated acoustical panels are available for such noise abatement structures. Properly erected, they will effect a transmission loss of 25 to 55 db, depending on thickness of the panels and their construction.

Absorption, however, is the best noise reduction measure for most purposes. Materials for absorption are available in wide variety. Prefabricated units are most popular because of their generally greater efficiency and uniformity. These units range from low-cost perforated cellulose fiber tile to metal pan-types with a thick sound-absorbent backing of mineral wool. Other types include mineral wool tile, glass fiber tile and panels, and perforated asbestos board with sound-absorbent backing.

All material is highly efficient, depending on type and thickness. Units will absorb up to 85 percent (and at certain frequencies up to 99 percent) of impinging sound. Average absorption coefficient is about 70 percent. Each type has advantages for certain installations. No particular one is best for all uses.

Generally, these materials are applied to the ceiling of noisy spaces and sometimes to the walls. In extreme cases, material is sometimes applied to both ceiling and walls. Excellent results can be obtained with acoustical baffles where overhead pipes or other structural features make it impractical to cover the ceiling. Baffles can be simply acoustical sheets or panels strategically spaced above the noisy area and suspended edgewise from the ceiling. Or they can be prefabricated types like the functional sound-absorber. This consists of a pyramid-shaped box of perforated sheet aluminum lined on all sides with sound absorbent material.

Proper solution of a particular noise problem — whether by isolation, absorption, or both — plus selection of acoustical materials to carry it out, are matters that call for services of an expert. Expert advice in these matters will pay off in the long run with better employee relations, more productive effort, and fewer rejects in your operations. ♦♦

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INDUSTRY POWER's contest to take you to the

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You may be the guest, all expenses paid, of INDUSTRY POWER at the 1956 Power Show to be held in New York City's new Coliseum next November. All you will have to do is tell why you should go to the Power Show. Perhaps you never have thought of reasons why you should go to the Power Show. Maybe you never have gone to any Power Show in past years. Perhaps you have never assembled the facts for your boss that would convince him of the very real values in attending the Power Show.

Here will be the opportunity to put on paper all the reasons you might need to sell the Power Show to your management. Here will be the opportunity to show the basic importance of the power services to your firm's operations. Here will be the chance to explain how power services are more than mere overhead . . . . how they are vital components of production costs . . . . how better techniques of handling the power services in your plant can significantly reduce product costs . . . . how these techniques of a lifetime may be picked up in a few days at the Power Show.

Full details are coming about INDUSTRY POWER's plan to take you to the Power Show. Watch for full details next month.

Look for the August issue of INDUSTRY POWER

Kids — stop pestering your daddy on his day off!

Look Mom . . . .
no subscription price!

Ever wonder why INDUSTRY POWER goes to qualified readers without demand of formal subscription price? Read how it is done. See page 11.

Roof insulation

. . . starts on page 22

Cost of heat loss per season (year) =

$$\frac{783{,}736{,}321}{1000} \times 0.00091 = \$713.20$$

Heat loss saving per year for insulated roof =

$$\$2260.40 - \$713.20 = \$1547.20$$

Years required to recover insulation cost =

$$\frac{\text{Excess cost of insulated roof}}{\text{Cost savings per year}} = \frac{\$380.00}{\$1547.20}$$

= 0.25 years or 3 months.

Sufficient time has not elapsed to determine the life of the new insulated roof. Roofing company has, however, issued a 20-year surety bond on it. This bond, in effect, guarantees the life of the roof.

A benefit obtained, not originally calculated, is that the plant area underneath the insulated roof is noticeably cooler on hot summer days than the portion of the plant not so insulated.

We have been completely satisfied with this approach to our problem. We plan to continue our reroofing program using this 1-inch treated fiber board insulation material on top of old roof. ♦♦

In brief . . . .

ASME Spring Meeting

RUSSIA HAS TURNED out three engineers for every two of ours over the past 25 years. This is what Joseph W. Barker, ASME president, told the recent Spring Meeting of ASME in Portland, Ore. Solutions to the problem, he said, will have to be worked out in community after community across the nation — in the high schools where to the young student decides what he wants to be.

In other papers, much of interest to power services engineers was reported:

Wood refuse spreader stoker firing

R. W. Martin, chief engineer, Eugene Water & Electric Board, Eugene, Ore.

"Prior to 1950, nearly all of the wood-refuse-burning steam generators were of the then conventional "Dutch Oven" type—employing a separate refractory-lined combustion space in which the fuel was partially burned in cone piles from which the volatiles are "distilled," providing combustible gases which completed combustion in the boiler furnace proper. In 1950 one of the first large steam generators of the wood-refuse-burning spreader stoker type was installed in the City of Eugene.

"Following the successful operation of one boiler specifically designed for spreader-stoker firing of wood refuse, and the successful conversion of one Dutch-oven-fired boiler to spreader-stoker firing, we feel qualified to make the following comments:

"1) The spreader-stoker firing principle is more flexible than the Dutch-oven firing principle in adaptation to multiple fuels. This is especially true of the traveling grate spreader stoker.

"2) The spreader-stoker is faster in its response to load changes, and is better adapted to the proper application of automatic combustion control.

"3) Maintenance cost of a spreader-stoker-fired boiler is comparable to that of a Dutch-oven boiler with equivalent water wall surface. Its availability, if different, is slightly better.

"4) The station operators, we believe, prefer the operation of the new and the converted spreader-stoker-fired boilers to the operation of the Dutch-oven-fired boiler.

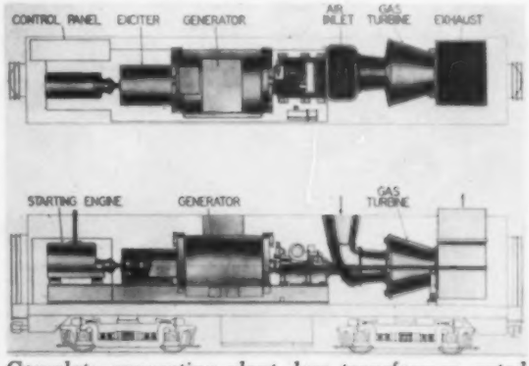
"Finally, if we install an additional boiler for wood-refuse burning, it will most certainly be a spreader-stoker-fired boiler, unless some further improvemen is made in design of the wood-refuse burning equipment."

Portable, 5000-kw gas-turbine power plants

H. H. Rupp, Industrial Gas Turbine Engineering, Westinghouse Electric Corporation, Lester, Pa.; and W. N. Hornberger, Engineering & Service Department, Westinghouse Electric Corporation, San Francisco, Calif.

"The gas-turbine generator set lends itself to skid mounting for a semipermanent installation with the entire plant installed on a monolithic foundation. With average soil conditions, the turbine-generator set can be mounted on a concrete mat approximately 50 feet long by 8 feet wide by 3 feet thick.

"In certain areas, the semipermanent plant introduces a new concept to power generation where the power plant can be moved to the source of fuel rather than the fuel being transported to the power station. This concept has proven practical in one



Complete generating plant, less transformer, rated 5000 kw is mounted on single railroad car.

installation where the gas turbine, located near the fuel source, generates power for approximately 2 mils per kw. This is less than new 30,000-kw steam plants in the same power system that require fuel to be transported to the plant site. . . .

"The gas-turbine prime mover has proven itself as either a peaking, emergency standby, or base-load plant to cover all normal phases of power generation. The plant described in this paper is the first mobile gas-turbine power-generating plant in this country, and is pioneering a new phase of flexibility in this type of gas turbine power.

(continues on page 52)

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Equipment ratings:
Boilers: Number _____ Total Capacity: _____ lb /hr
Total connected electric load _____ kva
Total transformer capacity _____ kva
Total number electric motors _____ Total hp ____
Total number pumps _____ Total hp _____
Total number compressors _____ Total hp _____
Products manufactured _____
Signed _____
Date _____

Outwitting outages

. . . starts on page 19

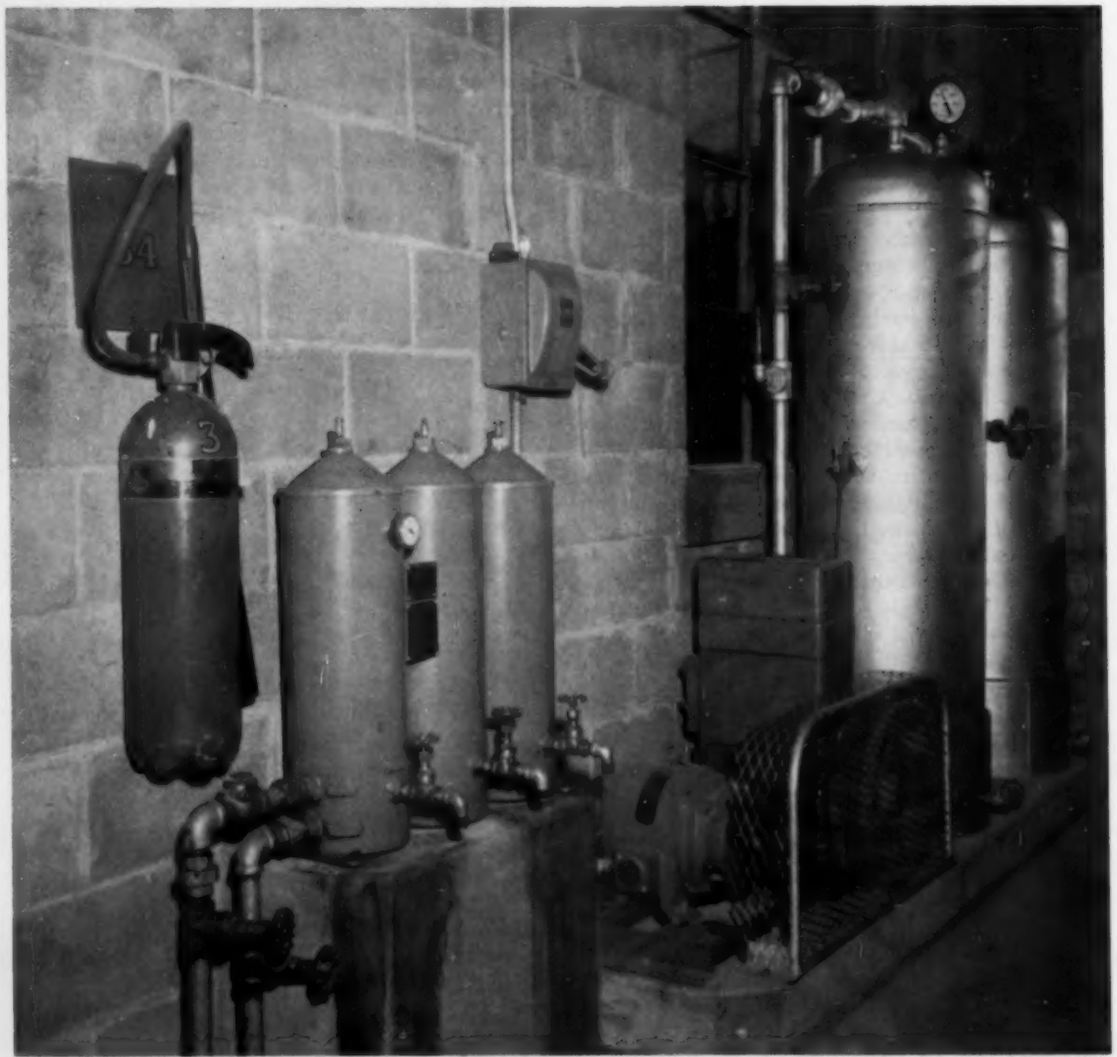
engine room through a filter mounted directly over the engine blower. Exhaust gases vent through a vertical silencer located outside the building. Starting air for the diesel is provided by a motor-driven compressor that automatically maintains constant pressure in two tanks in the engine room.

At present, the diesel unit is the primary source of production power. Currently, the engine is in operation 18 hours a day, 5½ days a week. The old diesels are operated during weekend and night hours when the production equipment is not in operation. They are also used for standby service.

Experience has justified the dependence upon the big engine for working power. Since this diesel has been in operation, there has not been a power service interruption in the plant. Beside, substantial savings in power costs have been effected because of the efficient dual-fuel operation of the heavy-duty engine. RMC is now protected against costly stoppages on the assembly line and orders are delivered on schedule. ♦♦

PRINCIPAL EQUIPMENT

Engine:	Fairbanks, Morse & Co. Model 31AD 8½, 360-hp., 6-cyl., 514 rpm. dual-fuel diesel	Lube cooler:	Ross Heat Exchanger Division of American-Standard
Alternator:	Fairbanks, Morse & Co. Type TGZO 265 KW 3-phase, 4-wire, 120-208 volt	Heat exchanger:	Ross Heat Exchanger Division of American-Standard
Governor:	Woodward Governor Co.	Thermostatic valves:	Fulton Sylphon Div., Robertshaw Fulton Controls Co.
Natural gas supply:	Indiana Gas Company	Exhaust silencer:	Maxim Silencer Co.
Fuel level meter:	Levelometer Liquidometer Corp.	Intake air filter:	Air-Maze Corp.
Fuel meter:	Buffalo Meter Co.	Gauges:	Marshalltown Mfg. Co.
Lube oil:	Standard Oil Co. (Indiana)	Pyrometer:	Alnor Illinois Testing Labs., Inc.
Fuel filter:	Purolator Products, Inc.	Alarm panel:	Viking Instruments, Inc.
Fuel transfer pump:	Ober Products	Cycle meter:	J-B-T Instruments, Inc.
Lube bypass filter:	Fairbanks, Morse & Co.	Electrical meters:	Burlington Instrument Co.
Lube full flow filter:	Cuno Engineering Corp.	Cooling tower:	Binks Mfg. Co.
		Circuit breaker:	I-T-E Circuit Breaker Co.



Some lube oil continuously bypasses through cartridge-type filter with disposable elements (at left).

Diesel economy improves 40 percent

Today's modern oil and dual-fuel turbocharged engines give us about 40 percent better fuel economy than we could get just before the war years. About 20 years ago the typical gas engine, in the 200 to 5000 hp class, consumed 10,000 Btu per brake-horsepower-hour. It operated on a compression ratio of about 6 to 1. Today's modern high-pressure turbocharged engines can easily develop a brake-horsepower-hour on 6200 Btu of gas and operate on a diesel compression ratio of 12 to 1.

In addition, the fine qualities which have been incorporated have resulted in greatly lowered operating and maintenance costs.

. . . W. E. Wechter
Manager, Engine Sales Division
Worthington Corporation

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Squeeze more efficiency

. . . starts on page 20

checks of steam screens, nozzles, and such have been made, check the tubes and tube sheets of the inner and after condensers. Be sure that they are not obstructed by any debris left over from piping work, and that condensate flows freely through all tubes.

check terminal difference

Terminal difference and temperature rise through these subatmospheric heaters should be carefully checked against the manufacturer's guarantee. Vent piping should be examined most critically. A very convenient way of continuous venting uses an orifice nipple in the vent lines. This can be made of cold-rolled steel approximately 3- to 4-inches long. It should have the same outside diameter as the piping involved, with threads cut on each end and a hole drilled through the nipple center. Sizing of this hole is somewhat experimental, but usually a ⅛- to ¼-inch hole will give adequate venting. Vents must be cascaded from one heater to the next, and then to the condenser, so that maximum heat recovery from vented steam and gas is obtained.

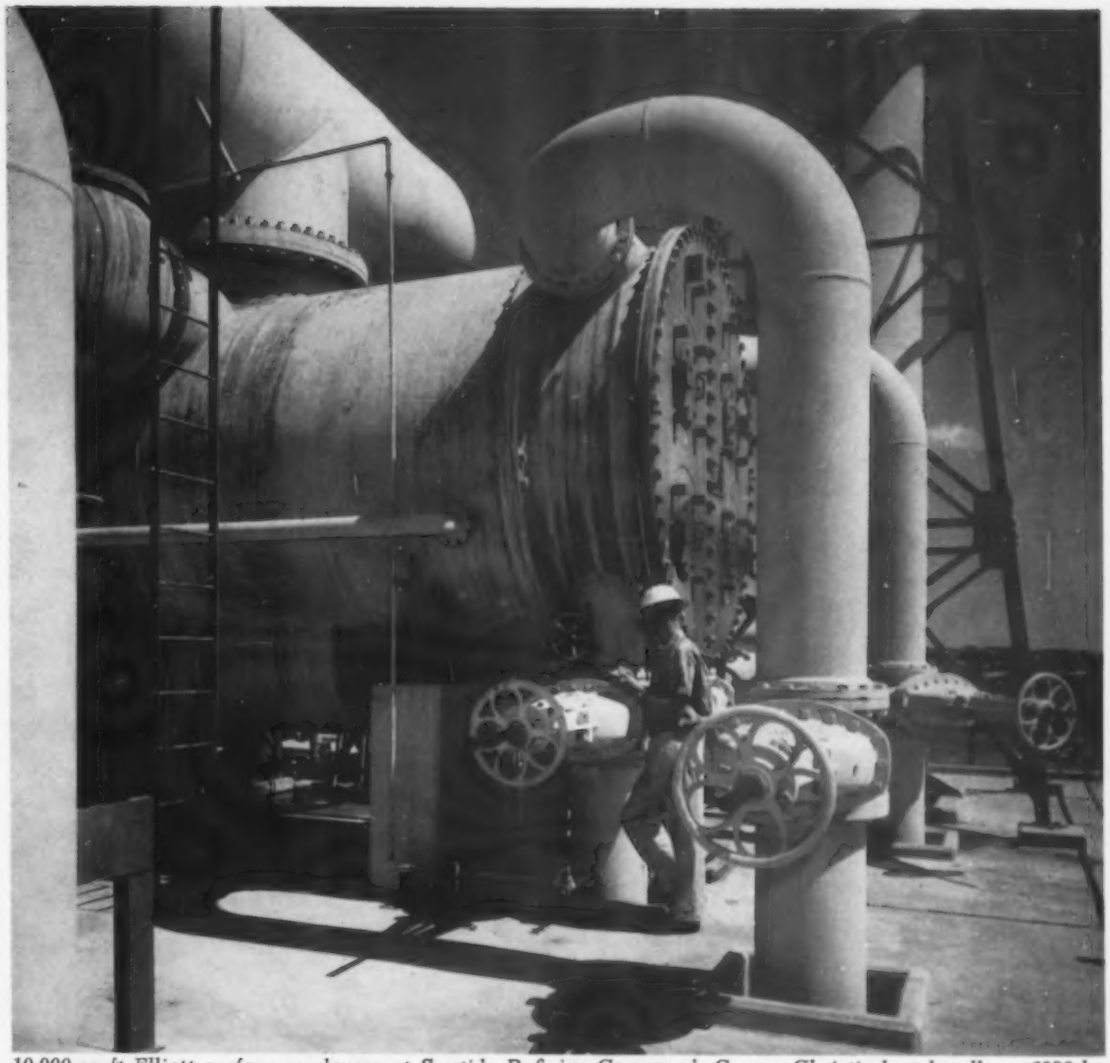
Extracted steam at this point in the heat cycle contains a considerable quantity of superheat. A desuperheating zone, or envelope, should be provided in this heater to remove the superheat because superheated steam acts as a gas and not as saturated steam until the superheat is removed. This results in a phenomenon known as negative terminal difference—temperature of water leaving the heater will be higher than or equal to the saturation condition in the heater by 2 or 3 degrees. It may be as much as 10 degrees. A complete discussion will be found in McAdams' "Heat Transfer."

Impingement baffles should be provided to protect heater tubes from impinging high-velocity steam. This should be checked with the manufacturer's specification sheet. Similarly, a subcooling zone should be provided in these heaters to reduce the temperature of condensed steam or drip to a minimum. This reduces flashing losses when the drip is cascaded to the next lower heater in the cycle.

Here again, gas removal, use of orifice nipples, and cascading heater vents is important. Adequate controls and good drainage will release operating staff when load changes occur.

Heater No. 2 at turbine extraction opening No. 3 is often of the direct-contact deaerating type. Its performance is of critical importance in the cycle. Accumulated noncondensible gases can be easily removed at this point.

If the deaerating heater has an external vent condenser, check for presence of dirt so that tubes and tube sheet are not fouled and cannot subject condensate return system to unnecessary back pressures.



10,000-sq ft Elliott surface condenser at Suntide Refining Company's Corpus Christi plant handles a 6930-hp turbine driving main air compressor with inlet 58,000 cfm, inlet pressure 14.5 psia, discharge pressure 42.7 psia.

Trays of this heater should be checked. If they are made of cast iron, replace them with stainless steel trays. Convenience in cleaning and reduced fouling will pay off. Venting is again of extreme importance. This vent, in particular, should blow freely at all times. To prevent waste of steam, a thermostatically controlled vent valve device may be used.

Extraction or nonreturn valves at extraction openings on the turbine (usually down to but not including the subatmospheric heaters) should be carefully examined. Check valves, stems, and packing, and look closely at seats and discs for any welding slag or other rubbish that has accumulated. Failure of these valves to function properly could produce runaway speeds under certain conditions of turbine tripout. Look out for the weird pipe fitting that always creeps into any piping job around these valves.

Makeup water is usually introduced at one of two points—either flashed in the condenser shell from a fresh water storage tank, or pumped to the inlet of this heater's vent condenser. Certain dissolved gases are always present in this water. Venting, reduction of oxygen and carbon dioxide to prevent boiler corrosion, and maintenance of high pH values in the drum water cannot be overemphasized.

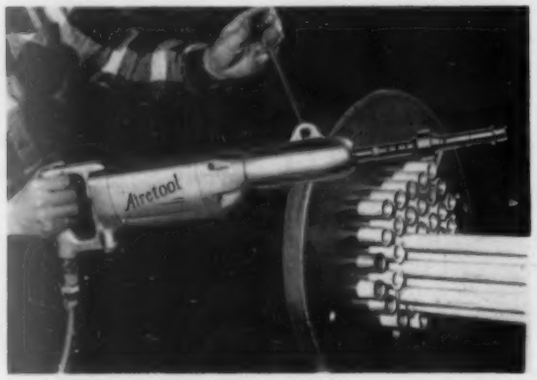
Work of this kind is necessarily slow and detailed. No startling effects in heat rate reduction will result. But any small improvement in power plant performance is worthwhile. That last half percent of efficiency, which is so difficult to obtain, is the most gratifying of all performance improvements. ♦♦

new products

. . . just circle key numbers on READ-N-CIRCLE card on pages 47 or 48

700-It's easy with internal cutter

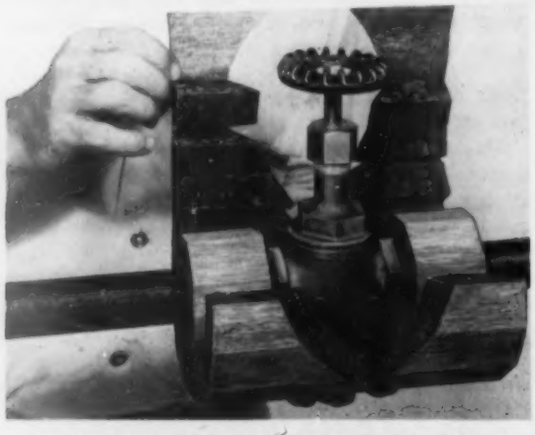
Lightweight, portable tube cutter is powered with either air or electric motor. Cutter's lever action and positive feed control give operator accurate control over cutting rate. Eliminates gouging and burning—increases tool bit life. Tube cutter is self-centering, and



double-action tool bits cut both nonferrous and steel tubes from ⅝- to 1-inch diameter through tube sheets 1-inch to 4-inches thick. Single-stage, air-driven motors provide speeds from 200 to 625 rpm. Alternate electric motor power provides speeds of from 190 to 560 rpm. AIRETOOL MFG. CO.

701-Cork insulating material

Low-temperature pipe insulating material can be cut with ordinary carpenter's saw and installed without bands, staples, or wire. Armstrong LT cork covering is

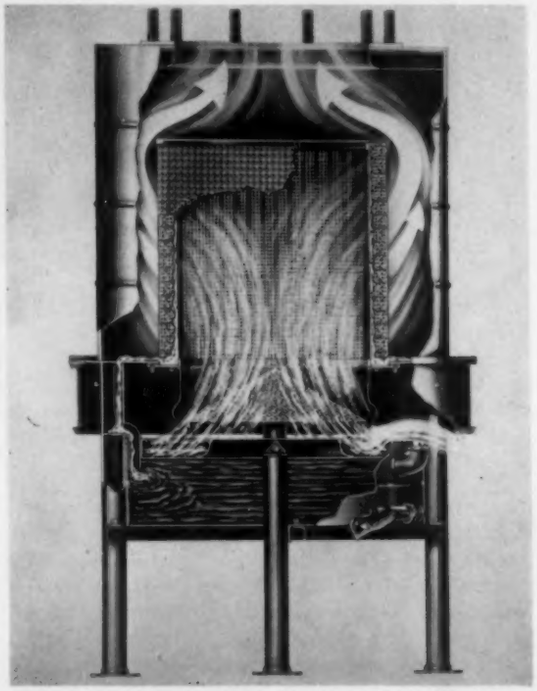


made of precision-cut segments of corkboard with backing of asbestos and aluminum laminated paper. Asbestos paper provides fire-resistant finish, and vapor-proof aluminum foil seals out unwanted mosture vapor.

Covering is applied by merely wrapping it around low-temperature lines and using adhesive to seal the lap. White asbestos exterior jacket eliminates necessity for painting on indoor installations. Use of adhesive reduces installation time and material damage. Insulating material can be removed and reused as required. Cork covering comes in three standard thicknesses and in 36-inch lengths to meet varying installation requirements. ARMSTRONG CORK COMPANY.

702-Air filter with low pressure loss

New oil-bath air filter combines oil scrubbing technique with extremely low pressure loss. Oil-bath filters have previously penalized internal combustion engine efficiency by their high static pressure losses. New filter reduces energy requirements and eliminates power-



consuming oil pumps. Filter's operating principle consists of air-flow regulator tube that maintains air velocity to insure full oil washing, yet keeps pressure drop low. Oil droplets and dirt are removed in cylindrical filter element. Oil and dirt flow inside the filter element and through oil return pipes to a sump. Pressure drop varies from 0.6 inch to 4.8 inch wg at capacities from 800 to 3500 cfm respectively. Models are available in capacities up to 24,000 cfm with maximum pressure drop of 3.5 inches wg. AIR-MAZE CORPORATION.

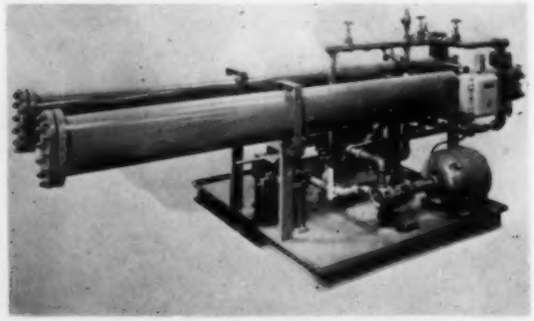
703-Find faults fast

Combination ground detector and fault locator can be used on normally ungrounded power circuits. Pulsating, audible signal is clearly distinguishable from background plant noises. Instrument can operate on circuits

buried in earth or concrete or on overhead circuits without necessity of placing exploring coil on conduits or cables. Lightweight instrument is housed in compact, portable case, 15 inches high, 8 inches wide, 7 inches deep. PARR MANUFACTURING CORPORATION.

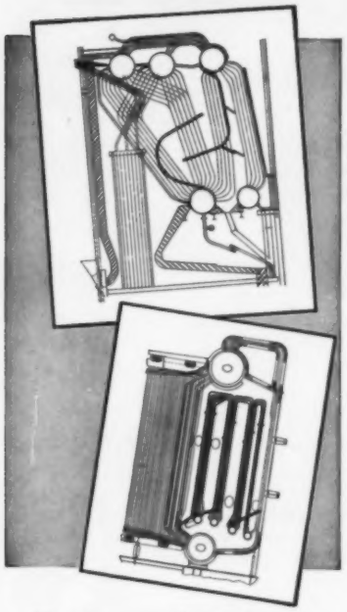
704-Fuel oil heater helps combustion

Fuel oil pump and heater unit accurately controls pressure and viscosity of heavy industrial fuel oils for better combustion. Unit heats fuel oil at rates to 3000 gph up to 300 F at 400 psi pressure. All units exceed



burner requirements with adequate safety factor. Controls and accessories include suction and discharge pressure gauges, temperature indicators, release valves, oil suction and discharge strainers. Single or duplex units are available for steam or electric power. WALTER H. EAGAN CO., INC.

ONLY ENCO BAFFLES give you all these COST CUTTING FEATURES



These important fuel-saving maintenance-reducing features are obtainable with Enco boiler baffles—*and only with Enco baffles.*

- **Streamlined gas flow**
- **Uniform gas flow**
- **Elimination of bottlenecks**
- **Reduced draft losses**
- **Higher heat transfer**
- **Cleaner heating surfaces**
- **Less use of soot blower**
- **Special provision for expansion**
- **Easy tube replacement**
- **Adaptable to any water-tube boiler, fired by any fuel**

Each application is designed on the basis of more than a quarter century of experience in this specialized branch of power engineering. Installations are made by skilled mechanics.

THE ENGINEER CO.
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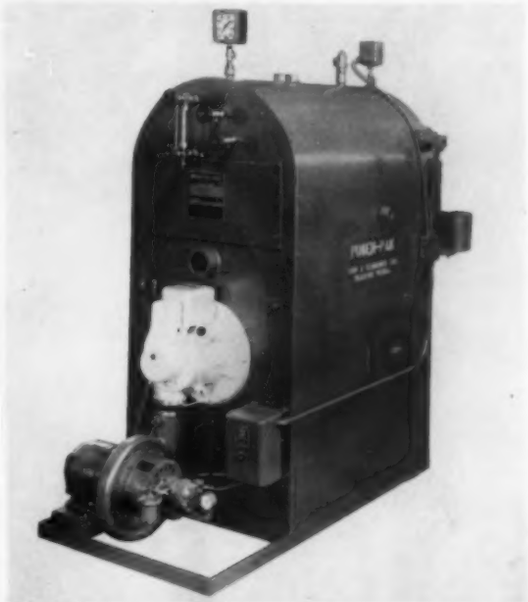
In Canada: Rock Utilities Ltd., 80 Jean Talon St. W., Montreal, P. Q. EC-908
Circle 115 on READ-N-CIRCLE card

705-Package boiler is portable

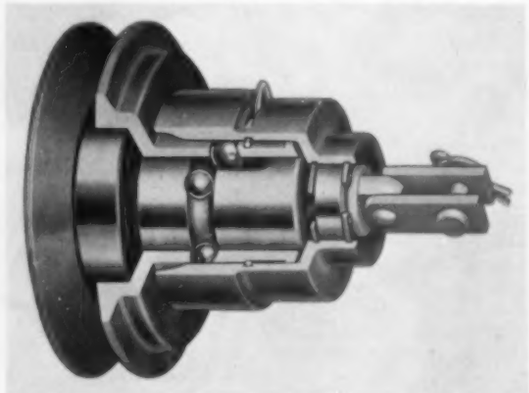
Low-priced package automatic boiler in capacities of 10-, 15-, 20-, and 25-horsepower provides steam or hot water for many auxiliary uses. Power-Pak units are designed for auxiliary use in large industrial plants and warehouses. Unit meets ASME standards of five boiler horsepower per sq ft of heating surface throughout its



full range. Units can be equipped with either oil- or gas-firing equipment, and are fully fire-tested before being shipped. Power-Pak is automatically responsive to load changes, and is ready for use after connection to power, water, and fuel lines. ORR & SEMBOWER, INC.

706-Clutch uses unique principle

New clutch consisting of three basic parts provides smooth, shockless engagement. Clutch mounts on electric motors, gas engines, and is suitable for use on



pumps, gear reducers, and other industrial equipment requiring intermittment and high-speed clutching. Clutches require 20- to 35-pounds closing pressure through short-stroke travel. Actuation can be by hand,

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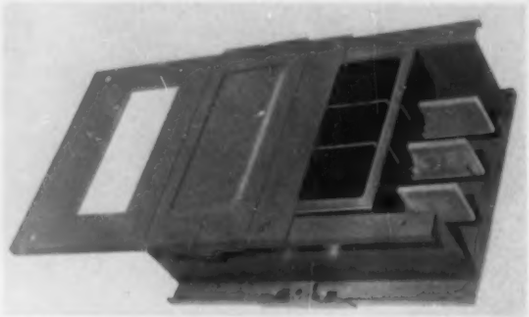
new products

. . . starts on page 34

cam, spring, air, solenoid, or other mechanical means. Release is instantaneous, since all V-belt pressure is removed as pulley sides open. Belt life is greatly increased because belt is completely relaxed when disengaged. Clutches easily handle high speed driving, and high rates of engagement and disengagement. V-Belt Clutch Company.

707-Bus takes high fault current

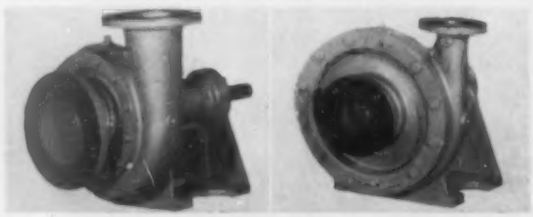
New design insulator for plug-in bus duct used on heavy-duty commercial and industrial electric distribution withstands fault current of 50,000 rms amperes.



High fault current rating provides advantages in modern high-capacity electric distribution system. Improved design eliminates damage to insulators and components, and insures safety and uninterrupted power during unforeseen emergencies. Federal Pacific Electric Co.

708-Centrifugal pump for rough service

New centrifugal pump will handle many head and volume characteristics without efficiency loss. Pump is available in five sizes: 2-, 3-, 4-, 5-, and 6-inch. Pump gives high efficiency over a broad range of service con-



ditions. Each size handles a wide range of pressures and capacities. Accommodates fluctuation in either pressure or capacity without serious loss of efficiency. Gardner-Denver Company.

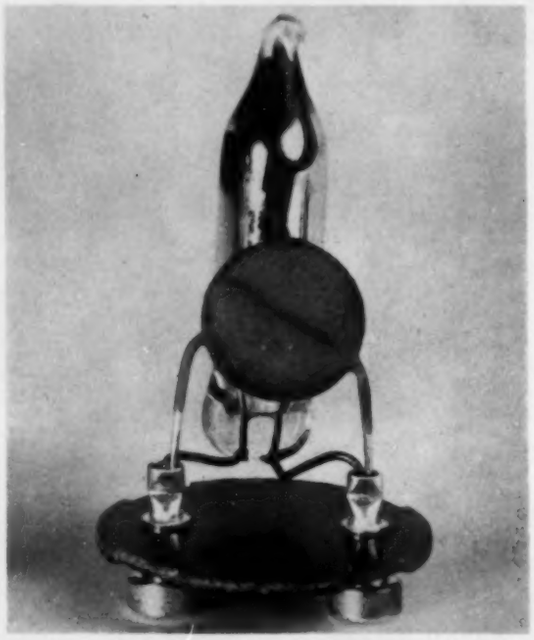
709-Electric or pneumatic level control

New pneumatic, snap-acting switch mechanism gives rugged, dependable fluid level control. Pneumatic switch can be actuated by a float, displacer, flow piston, or valve stem that raises or lowers a magnetic sleeve in or out of a magnetic field. Switching action may be easily changed from "close on low" to "close on high" by a simple adjustment of mechanical linkage.

Switch is designed to close "bubble tight" against 100 psig air pressure. Normal instrument air pressures are in the range of from 5 to 15 psig. All working parts are stainless steel for corrosion resistance when used on corrosive instrument gases. Level control is furnished in all styles — external float cage, top and side mounting, and displacement type. Magnetrol, Inc.

710-Starters for rough duty

Fluorescent starters using new ceramic condensers that will operate under extreme conditions of heat, cold, and humidity are now available for industrial and commercial lighting. Increased starter life means reduced

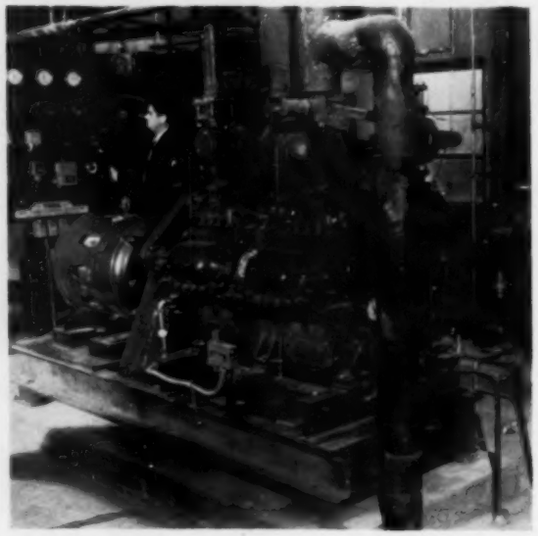


maintenance costs for industrial and commercial fluorescent lighting. Compact ceramic condensers will withstand temperatures of 300 to 500 F for extended periods. Present-day condensers seldom withstand more than 148 F. Sylvania Electric Products Inc.

711-System heats with outside air

First practical system of obtaining heat from below freezing outside air is now available. Heart of the system is a new heat pump that combines with compound compression to heat or cool building depending on climatic conditions. Heat pump can remove heat from 0 F outside air while cooling air to still lower temperatures. Thermostatically controlled valves regulate hot- or cold-water flow in and out of the system. Compressors automatically move from single,-to compound-stage compression when temperature drops below a preset point. Heat removed by refrigerant from outside air is elevated to usable temperatures by compression cycle. This heat is then used to provide hot water or hot air for heating building spaces.

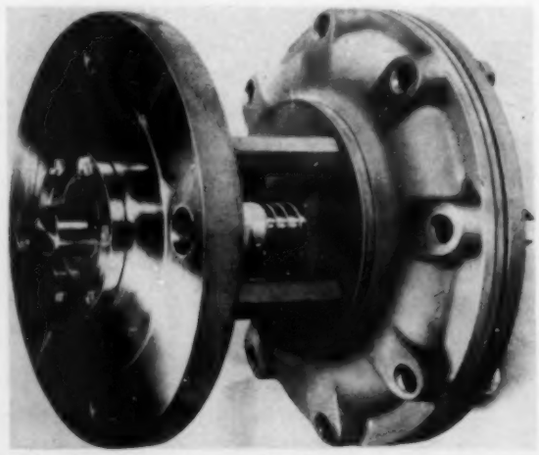
Conversely, expansion, or cooling of refrigerant ex-



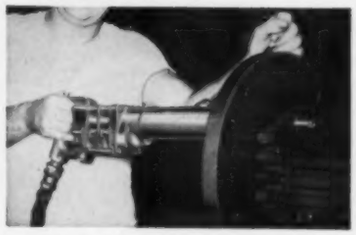
tracts heat from cooling-water media. Resulting chilled water is piped throughout the building to provide cooling. The York Corporation.

712-Pressure transmitter without bellows

Low cost, pneumatic pressure transmitter operates on forced-balance principle without bellows element. Lightweight, rugged, highly sensitive unit is ideal for services involving viscous substances or materials that solidify in bourdon tube static lines. Transmitter uses simple, flat diaphragm in place of bellows.



Use of diaphragm eliminates problem of viscous materials hardening in bellows convolutions. Diaphragm can be supplied in rubber, Teflon, or stainless steel, depending on temperature range and corrosion resistance desired. Pilot is completely isolated from pressure diaphragm to prevent controlled gas or liquid from entering into air lines in event of diaphragm failure. Conoflow Corporation.



Here's the modern, cost-saving method of removing leaky or damaged tubes from heat exchangers and condensers. With the AIRETOOL Internal Tube Cutter you accomplish overhauls in short order . . . eliminate costly downtime . . . replace faulty tubes in HOURS, not DAYS! A powerful single-stage air motor drives this fast-cutting lightweight tool. Two self-centering hardened tool steel cutting blades quickly and easily cut steel or non-ferrous tubes, internally, from ⅝" to 2½" O.D., 12 to 20 gauge, through tube sheet thicknesses of 1 inch to 4 inches. Adjustable ball bearing thrust collar prevents friction or binding while a positive feed control permits the operator to govern the cutting rate. For full complete information on the AIRETOOL Internal Tube Cutter, see your nearest AIRETOOL representative, or contact the AIRETOOL Mfg. Co. for illustrated literature.

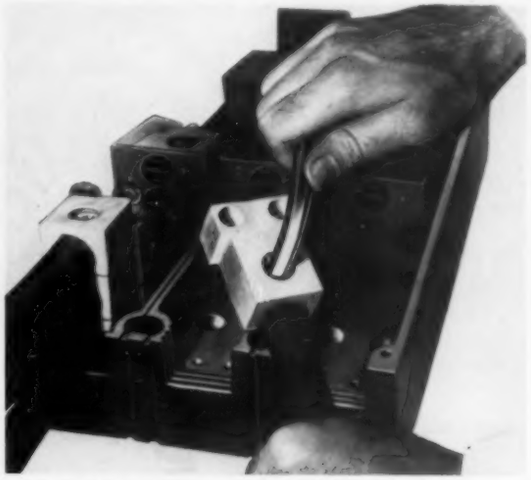
REPRESENTATIVES: in principal cities of U.S.A., Canada, Mexico, England, Puerto Rico, Hawaii, South America, Italy, Japan.
EUROPEAN PLANT: Vlaardingen, The Netherlands

BRANCH OFFICES: New York, Chicago, Philadelphia, Tulsa, Houston, Baton Rouge.

Circle 126 on READ-N-CIRCLE card

713-Circuit breaker range extended

Molded-case circuit breakers are now available for operation at 800-ampere current rating. New circuit breaker extends operating range of molded-case breakers from 600 to 800 amperes, with Underwriters' Laboratory approval. Optional pressure connectors are offered for either double- or triple-cable connections per



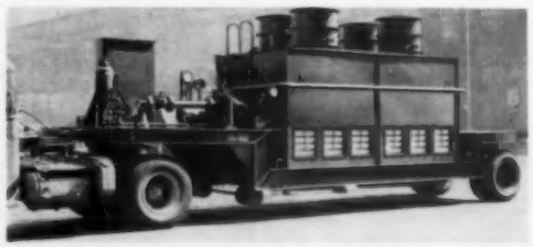
phase within circuit breaker case. Breaker is provided with interchangeable trip units providing continuous 600-, 700-, or 800-ampere ratings in 2- or 3-pole construction for 250-volt dc and 600-volt ac service. New 800-ampere breaker can be used in panel boards, power panels, switchboards, motor controls, and bus duct plugs. I-T-E Circuit Breaker Co.

FREE INFORMATION

For detailed free information on these products just circle the key numbers on the READ-N-CIRCLE card on pages 47 or 48.

714-Cooling tower travels to job

Packaged water cooling-tower plant is wheel-mounted for easy transportation to job site. Unit is compact, lightweight, and equipped with all necessary accessories such as pumps, strainers, electric control equipment, pressure gages, thermometers, and feedwater



conditioner. Unit will cool 240 gpm of 115 F water to 90 F when operating at 95 F ambient temperature and 80 F wet-bulb temperature. Package unit shows promise for increasing the cooling capacity of isolated plants. Badger Manufacturing Co.

"We saved $120,000 here by installing Reznor heaters instead of replacing a worn-out boiler"

"When the old heating boiler at this plant gave out, we were told it would cost $150,000 to replace it. Then we discovered we could have a Reznor heating system for approximately one-fifth of that cost. It's a big building . . . 165,000 square feet of space to be heated. It took 64 Reznor heaters and over 20,000 feet of pipe to do the job, but we saved $120,000 on equipment and original installation. And we're saving a lot more on operation and maintenance costs. For example, we saved $15,000 a year in salaries by eliminating the four men formerly needed to operate the boiler room. And the plant is more comfortably heated than it ever was before."

Only Reznor Gas Unit Heating Offers All These Advantages

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new bulletins

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400-Precast concrete stack data

Engineering data on precast refractory stacks for all uses is given in this bulletin. Four categories give information on specifications, installation instructions, performance data, and physical characteristics. Precast stacks can be used where flue gas temperatures do not exceed 1600 F. Precast stacks are made up in 3-foot sections and are installed by cementing one section to another with acid-proof, high-temperature cement. Aluminum outer jacket eliminates maintenance and painting. Eighty pages. VAN-PACKER CORPORATION.

401-Electric instrument manual

Engineering data on instruments for testing and calibrating current-actuated protective devices is contained in Catalog 3561. Application recommendations, illustrations, and schematic diagrams are listed in this catalog. Includes recommendations for electric maintenance personnel on safe techniques for rapid inspection of critical protective equipment. Includes full line of standard and special equipment. Sixty-eight pages. MULTI-AMP CORPORATION.

402-Pressure water filters explained

Design features, engineering details, and uses of pressure sand and gravel water filters are described in Bulletin WC-107A. Lists controls, accessory equipment, and includes table of capacities, sizes, and space requirements. Cutaway views are included for both horizontal and vertical filters with details of strainers, distributor system, and piping arrangements. Twelve pages. GRAVER WATER CONDITIONING CO.

403-Package liquid chiller data

Data on the complete line of package liquid chillers are contained in Catalog 50-D. Includes general specifications, installation dimensions, for all models. Also includes selection and performance tables. Gives an easy-to-understand example of how to select the proper liquid chiller for normal water cooling applications. Eight pages. ACME INDUSTRIES, INC.

404-Combination variable pulley manual

How variable pulleys operate and what function they perform is described in Catalog 60-A. Includes engineering section to facilitate selection. Lists formulas for calculating center-to-center distances and gives tables of possible speed variations. Includes installation dimensions and describes the procedure to select the most efficient combination pulley drive. Eighteen pages. LEWELLEN MANUFACTURING CO.

405-Gas-fired heaters save space

Advantages of gas-fired commercial and industrial heating units are fully described in Catalog GN-56. Includes data on suspended gas unit heaters, both fan and blower types, in capacities from 25,000 to 250,000 Btu. Lists specifications, construction details, easy-to-read dimension drawings, and selection tables. Describes how suspended heaters save valuable floor space for process operations. Twenty-four pages. REZNOR MANUFACTURING COMPANY.

406-Fluorescent lamp ballast data

Bulletin GEC-983H contains new data on the complete line of weatherproof fluorescent lamp ballasts. Also lists wiring diagrams and electrical specifications for ballasts. Cover ballasts for general line fluorescents, outdoor applications, rapid-start and circline lamps. Includes schematic wiring diagrams for proper installation of ballasts in most common circuits. Twelve pages. GENERAL ELECTRIC COMPANY.

407-Power transmission manual

Power transmission equipment including flexible couplings; variable-speed pulleys and transmissions; and universal joints and motor bases is described in this bulletin. Includes operating data, horsepower ratings, and equipment for widely varying conditions. Horsepower ratings include values from fractional to 3000. Variable-speed pulleys give speed ratios of up to 8:1, in ratings from ¼- to 15-horsepower at 750 rpm. Twelve pages. LOVEJOY FLEXIBLE COUPLING CO.

408-Cleaner air with precipitators

How to clean air by electrostatic precipitation is described in detail in Bulletin B-1425. Includes illustrations and specifications describing installation, operation, and maintenance of Precipitron units. Describes salient features that permit unit operation to be controlled from outside location. Eight pages. WESTINGHOUSE ELECTRIC CORPORATION.

409-Read about welding electrodes

Latest developments in welding electrodes are described in Bulletin SB-1351. Includes data on newest iron powder and other electrodes. Describes physical properties, chemical composition, and recommended welding procedures for each electrode. Includes operator's reference table. Illustrations show correct techniques and illustrate good welding results. Twenty-eight pages. THE LINCOLN ELECTRIC COMPANY.

410-Metal panels give permanent buildings

Need more space? Bulletin 12-C-1 contains information on standard corrugated, mansard, and V-beam steel sheet for all construction purposes. Easy-to-follow instructions show versatility of construction. Includes engineering data, load tables, radii of curvature, and properties for each type of steel sheet. Includes cutaway sections showing fastener details. Lists table giving paint and coatings recommended for sheet roofing and siding. A recommended manual for all engineers concerned with building additions. Forty-four pages. H. H. ROBERTSON COMPANY.

411-Scale models save money

Three-dimensional engineering models can save money in design of your new process and power plants. Model components can be assembled to help visualize the best possible arrangement for power and process equipment. Piping, conduits, ducts, and conveyors are located to show clearances and most efficient location. Scale models can be constructed to suit requirements in any price range. Eight pages. ATKINS & MERRILL INC.

412-Store liquids in concrete tanks

Prestressed concrete tanks for storing industrial liquids, wastes, and water are described in Bulletin T-12. Defines prestressed tanks, and lists advantages of minimum maintenance costs. Illustrates construction procedure and gives specifications and limitations for concrete tanks. Four pages. THE PRELOAD COMPANY, INC.

413-Scotch-type boilers save steam

Scotch-type boilers engineered for forced-draft oil, gas, or gas-oil burners are described in Catalog AP-294. Fire-tube boilers are constructed with unobstructed water wall as rear wall of combustion area. Catalog includes component parts, ratings, capacities, recommended burner sizes, installation dimensions, and engineering data. Water wall insulating effect prevents escape of usable heat into boiler room. Eight pages. PACIFIC STEEL BOILER DIVISION, NATIONAL-U.S. RADIATOR CORPORATION.

414-Erect your own storage facilities

Versatility, strength, and economy are features of slotted angle-iron construction. Lists accessories such as steel panels for shelving, stair treads, and casters for movable equipment. Shows installations with many illustrations of typical uses. Twelve pages. DEXION DIVISION, ACME STEEL COMPANY.

415-Instrument tubing in bundles

Copper, aluminum, and polyethylene instrument tubing available in single, or 37-tube bundles is described in Bulletin 456. Gives information on advantages, limitations, installation recommendations, and available stock sizes and colors for each product. Individual tubes come in standard copper tubing sizes. Connections are easily made with standards fittings. Four pages. DEKORON PRODUCTS DIVISION, SAMUEL MOORE & COMPANY.

416-Compact boilers increase efficiency

Portable or permanent package boilers that give maximum power in minimum space are described in this bulletin. Boilers are available from 30 to 350 horsepower with steam capacities up to 12,075 lb/hr. Internal tube construction provides greater heat transfer surface and more even heat distribution and extraction. Equipment is fully automatic for gas-, oil-, or combination-fuel-firing. Lists capacity tables and dimensions for 11 models in the line. Eight pages. BROWN FINTUBE COMPANY.

417-Idlers improve conveyor belt handling

Design and application data on belt conveyors for bulk materials is contained in Bulletin 2-47. New design idlers consist of resilient neoprene or rubber discs molded to a flexible wire rope. Freely suspended idlers form a trough with each idler turning on its own axis. Idlers center the load, guide the belt, and provide a

cushioned ride to keep belt wear and spillage to a minimum. New idlers provide for up to 50-percent increased spacing. Twelve pages. JOY MANUFACTURING COMPANY.

418-Basics for precipitators

Five basic engineering requirements for a successful precipitator installation are discussed in Bulletin 104. Discusses positive control of gas flow, high, uniform electrode emission, continuous cycle rapping, simple construction, and trouble-free, high-voltage equipment. Also discusses nine time-tested steps to a successful intallation. Twenty-four pages. BUELL ENGINEERING COMPANY.

419-Steam trap manual

Real low-down on steam trap operation is contained in "Armstrong Steam Trap Book." Includes many illustrations of correct steam trap installations. Cutaway sections show steam trap operating principles. Lists steam traps for all sizes from ½ to 2 inch. Includes data on how to trap unit heaters, submerged steam coils and tubes, siphon drains, and low pressure heating systems. Includes illustrations of typical piping layouts incorperating steam traps. Forty-six pages. ARMSTRONG MACHINE WORKS.

420-Get up-to-date on painting

Keep up-to-date on the latest procedures for maintenance painting, as described in this bulletin. Describes spray gun equipment that can be used effectively with various materials. Includes guide to proper equipment selection for a specific painting job. Also lists complete line of accessories, including portable paint heater. DE VILBISS COMPANY.

421-Considering diesel-electric?

Bulletin 31922 describes the many different uses to which diesel-electric generating plants can be put. Cutaway drawings and illustrations show installations as auxiliary, emergency, and portable equipment. Lists advantages of compactness, ease of operation, maintenance, reliability, and power output. Sixteen pages. CATERPILLAR TRACTOR CO.

422-Get more from steam pumps

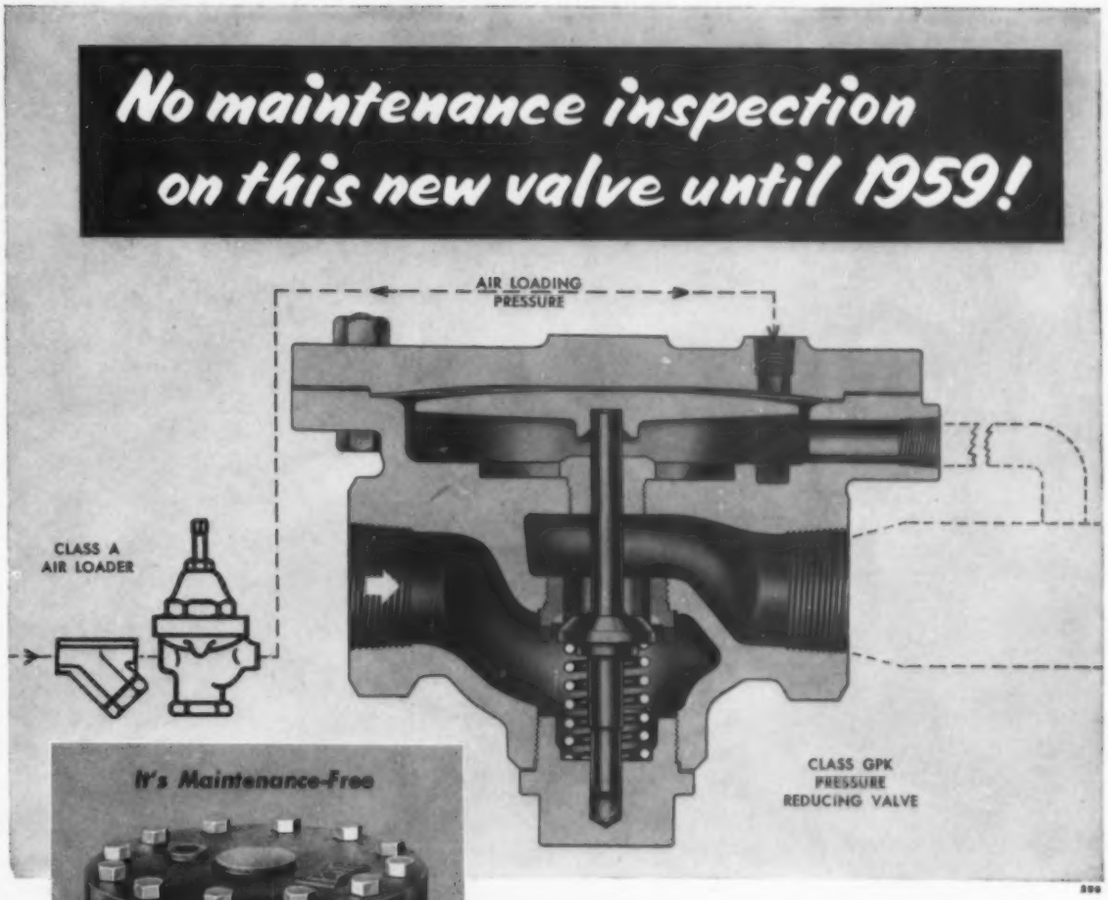
Step-by-step illustrations, in Bulletin G-2280 P, give reader information on how to increase service life of all steam pumps. Offers 28 tips on proper installation and 54 tips on field-proven care techniques. Bulletin is specifically designed to aid operators and maintenance men in adding years of reliable service to steam pumps. Twenty-three pages. WORTHINGTON CORPORATION.

423-Lowdown on blowdown

New concept uses quick-change orifices to control boiler blowoff, as discussed in Bulletin 152. Text describes installation and operating procedure for this unique, easily controlled system. Illustrations show typical installation and show how quick-change orifices can be replaced in a minimum of time. Four pages. THE UNIBLOW VALVE COMPANY.

424-How to solve vibration

How to solve machinery mounting problems, eliminate vibration, and control noise are discussed in Bulletin K6A. Gives case histories showing how these prob-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This amazing new, diaphragm operated, Leslie pressure reducing valve has *only two moving parts:* no seals; no stuffing boxes; no small, dirt-catching parts.

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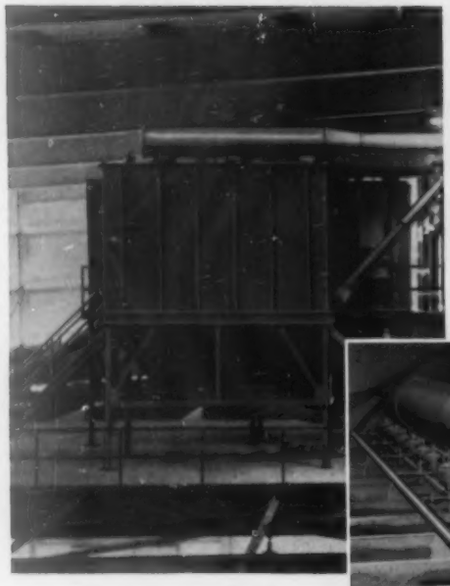
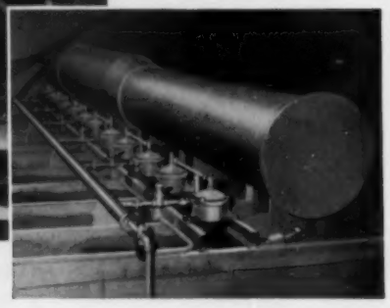
Norblo gives you continuous peak-load Dust Collection



through automatic bag cleaning



Plants running full blast can ill-afford down time for equipment repairs and maintenance. Dust collection around the clock without interruption is commonplace with Norblo Automatic Bag Type Arresters.

Complete time-cycles for progressive automatic bag shaking are controlled by highly efficient electric timers. Only one compartment is cut out at a time, and that for just a few seconds, with *no* drop in efficiency for the installation as a whole. Norblo's compartment construction is the time-saving solution to inspection, maintenance and repair in busy plants . . . For "good housekeeping" or for salvage, Norblo Automatic installations have many design advantages wherever continuous high recovery of industrial dusts and fumes is important.

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THE NORTHERN BLOWER COMPANY

6422 Barberton Ave., Cleveland 2, Ohio OLympic 1-1300

Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

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new bulletins

. . . starts on page 38

lems are solved using steel springs, cork, and rubber isolation media. Includes selection chart giving cost and capacity of vibration and noise control mountings. The Korfund Company, Inc.

425-Considering a new steam generator?

Compact, fully automatic, vertical steam generator with guaranteed ratings is described in Bulletin 586. Describes water-tube boiler arrangement without drums and headers. No internal water reservoir is needed. Available for either gas or oil firing. Vertical steam generator is ideally suited for portable mounting. Chart lists models from 18 to 160 hp. Twelve pages. Vapor Heating Corporation.

426-How to select the right wire rope

"Wire Rope Recommendations for Industrial Services" contains information on more than 120 different types of wire ropes for all industrial applications. Bulletin DH-128D discusses how to select the proper wire rope and covers such points as rope diameter, construction, preforming, lay, grade, and core. Includes charts covering weights and breaking strengths for wire rope and fittings. Twenty-four pages. American Chain & Cable Co.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on pages 47 or 48.

427-Improve heat transfer

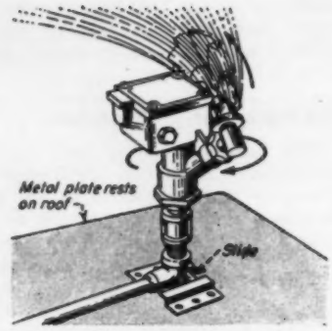
Engineers involved with design, maintenance, and repair of condensers and heat exchangers will benefit from information and data contained in Bulletin TB-412. This technical folder emphasizes the quality, dependability, and economy of electric-resistance-welded carbon steel tubing in all heat transfer applications. Includes a chart that outlines the hydrostatic test pressures required for various sizes of tubes under ASTM A-214. Six pages. Tubular Products Division of Babcock & Wilcox Company.

428-Do you want the right roller chain?

Complete line of precision roller chain and sprockets is described thoroughly in Link-Belt Book 2457. It includes sections on stock drives, drive chain, conveyor chain, sprocket wheels, casings, chain tighteners, installation, maintenance, and lubrication. Well illustrated book gives all the information necessary to choose the right roller chain for any application. 148 pages. Link-Belt Company.

429-Power transmission encyclopedia

Here is a valuable reference book for all engineers interested in mechanical power transmission machinery. Completely covers base plates, bearings, chains, clutches, collars, couplings, keyseats, pulleys, shaftings, speed re-



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ducers, sprockets, takeups, and bushings. A special section is devoted to belts, drive tables, sheaves, and variable speed tables. Worth keeping on your book shelf. 328 pages. DODGE MANUFACTURING COMPANY.

430-Better lighting from fluorescents

Advantages of a new prismatic-fluted glass for fluorescent fixture lighting panels is described in Bulletin L-110-C. Crysta-lite is recommended for large area general lighting applications. Bulletin gives complete photometric data for two-lamp 12-inch troffers, three-lamp 12-inch troffers, and four-lamp 24-inch troffers. Includes brightness and distribution data, testing conditions, and coefficients of utilization. An illumination level calculating sheet is also included. Six pages. CORNING GLASS WORKS.

431-Fire alarm specifications simplified

Useful guide for preparation of fire alarm specifications has now been published in the form of a ten-page bulletin. Bulletin is concerned primarily with systems that warn all occupants of the building being protected, such as would be installed in factories, schools, hospitals, and hotels. National Fire Protection Association Code No. 72 Proprietary Auxiliary Remote Station and Local Protective Signaling Systems is discussed in detail as to its application to these installations. Sections of these standards are quoted verbatim and then explained in detail for handy reference. Ten pages. EDWARDS COMPANY, INC.

432-Small horizontal steam turbines

Line of small horizontal steam turbines that are suitable for driving boiler feed pumps, stokers, forced and induced draft fans, condenser pumps, generators, and similar units that require continuity of service are described in Bulletin 100-1-A. Type BT turbines have all the advantages of the larger horizontal steam turbines offered by this company. Four pages. THE WHITON MACHINE COMPANY.

433-Motor compressor catalog

A comprehensive presentation of the line of ¼ through 3 hp semi-automatic condensing units and high-torque motor compressors is available in Bulletin G-141. Bulletin is designed to give the reader quick and accurate access to eight separate sections, including water-cooled. combination air- water-cooled, capilliary tube and truck units. Also contains a brief summary of the building-block compressor rack, which permits the convenient mounting of any number of Brunner-Metric condensing units. Twenty-four pages. BRUNNER MANUFACTURING COMPANY.

434-Looking for a new crane?

Complete line of underhung overhead cranes with a broad range of applications is illustrated and described in Bulletin U-200-1. Types of cranes featured include push-type flexible bridge and standard, hand geared, and various modifications of motor-driven types. Two pages are devoted to various types of hangers for monorails and underhung crane runways. Complete truck and trolley data is also provided with several pages of electric information covering collectors, conductors, controls, motors, reducers and bridge drive. CHICAGO TRAMRAIL CORPORATION.

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The man who named Tombstone, Arizona

THE SURPRISED government scout from Camp Huachuca reined his horse to a stop at the sight of Ed Schieffelin. And when Schieffelin admitted he was actually living and prospecting in Apache country, the scout warned him, "All you'll ever find'll be your tombstone."

But Schieffelin didn't scare easy. When he struck a silver lode in the desolate, dangerous hills of Arizona Territory, he called his first mine "Tombstone." And, unknowingly, he gave a name to a borning, brawling community soon to be notorious as one of frontier America's tough towns.

The Tombstone mine itself never amounted to anything. But Schieffelin just kept on prospecting – and within a few years, he turned out to be a millionaire. The hills he had risked his life in were practically made of silver.

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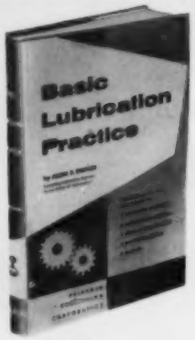
A PRACTICAL data book for engineers, operators, maintenance men . . .

BASIC LUBRICATION PRACTICE

by ALLEN F. BREWER

Consulting Lubrication Engineer



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basic bulletins

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AIR CLEANING EQUIPMENT

500-Series on dust and fume collectors

Exhaust fans for dust collecting and air handling are described in Catalog 1002-6. Includes complete performance tables and test curves. Plans and elevations of typical installations are shown. Separate additional bulletins contain descriptions, dimensions, capacities of Norblo bag type, hydraulic type, and centrifugal dust collectors. THE NORTHERN BLOWER CO.

501-Dust collection manual

"The Collection and Recovery of Industrial Dusts," Manual 101, discusses various types of dust and techniques used in analysis, lists the factors which influence choice of equipment, and explains operation. Thirty-two pages. BUELL ENGINEERING CO., INC.

502-Dust collector manual

Dust collectors, including cyclone, wet or dry dynamic, and cloth screen arrester types are the subject of a 32-page bulletin. Uses of air conditioning, ventilating, conveying, drying, and cooling units are presented. KIRK & BLUM MFG. CO.

BOILERS AND BOILER ACCESSORIES

503-Can your boiler burn refuse?

Boilers specifically engineered and installed to utilize refuse (such as wood chips and coffee grounds) as fuel are described in Bulletin 55-1. Includes engineering drawings of boilers in capacities up to 5000 lb/hr of steam. Lists complete line of accessories such as economizers, air heaters, and superheaters. Fourteen pages. THE WICKES BOILER CO.

504-Heating with hot water?

Bulletin 923 contains an easy-to-understand discussion of the problems relevant to industrial hot-water heating. Schematic diagrams of typical closed and open storage-type hot-water systems are included. Presented in question-and-answer form, it discusses questions on all phases of hot-water heating. Fourteen pages. FRED H. SCHAUB ENGINEERING CO.

505-Boiler setting and baffle data

More than 30 boiler-setting plans are shown, with an analysis of how each arrangement of tubes is baffled to meet the specific boiler design, in 20-page Bulletin BW-54. THE ENGINEER CO.

506-Answers to hot water problems

Answers to your hot water problems are given in Booklet "Methods and Means." Operation and advantages of the instantaneous water heater as compared to the indirect method heater are thoroughly discussed and illustrated. PICK MANUFACTURING CO.

507-Complete boiler data

Complete data and specifications on each of the models and sizes in the "S" series line of boilers are given in eight-page Booklet WT-8. Units discussed range in capacity from 10,800 to 50,000 lb/hr. Other power equipment made by this company is discussed briefly. WM. BROS. BOILER & MFG. CO.

508-Vertical unit boiler advantages

More than 25 years of development, manufacturing, and application experience are reflected in the design of the Type VU-10 vertical-unit boiler described in 16-page Bulletin VU 10-8. Advantages and design features are discussed. COMBUSTION ENGINEERING, INC.

509-Blowoff heat is free heat

Recover practically all of the heat of the blowoff water in a continuous blowoff system. Bulletin 5700 uses diagrams and text to explain how this steam may be used to heat feedwater in an open or deaerating heater and how it may be condensed in a closed heater or flash condenser to heat feedwater at a point beyond the deaerating heater. COCHRANE CORP.

510-Package boiler improvements

Seven-page Bulletin AXY-1 gives full operating details and describes changes that have been made in the

CONTINUOUS BLOWDOWN WITHOUT HEAT LOSS!

You can be assured of absolute automatic control of boiler water concentration with the Henszey Boiler Blowdown. Automatic control is assured **without heat loss** regardless of boiler load.

This compact, self-contained unit can be easily and quickly installed by your own men.

For further information write . . . .

Our field engineers will call at your plant on your request.

HENSZEY

HENSZEY COMPANY

Dept. A, Watertown, Wisconsin

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Amesteam generator, which is factory assembled, for 15 through 200 psi pressures. AMES IRON WORKS, INC.

COMMUNICATIONS SYSTEMS

511-How to select industrial signals

Three major factors in signal selection are discussed in this bulletin: purpose of signal; areas to be covered; and noise levels to be overcome. Discusses general alarm, start and dismissal, coding or paging, and danger signals, for outdoor and indoor areas. Illustrations show recommendations for a typical plant. Condensed chart shows range for each signal type. Eight pages. FEDERAL SIGN & SIGNAL CORPORATION.

COMPRESSED AIR SUPPLY

512-Air compressor reference data

Engineering data and dimensional installation drawings are contained in Bulletin L-640-B1C to aid in selecting the proper air compressor for your plant air-supply needs. Complete compressor installation diagram is included along with various cutaway views of major components and accessories. An excellent reference bulletin for any future air compressor installations. Twenty-four pages. WORTHINGTON CORPORATION.

513-Air compressor selection guide

Bulletin 36 is a comprehensive text for selecting the proper air compressor for your job. Includes a detailed engineering section and tables of computations to insure correct installation. Also contains descriptions, specifications, dimensional engineering drawings, and representative photographs of the complete line of single- and two-stage compressors. Other sections include information on continuous operating compressors, accessories, and controls. Forty-four pages. BRUNNER MANUFACTURING COMPANY.

CORROSION CONTROL

514-Handy protective coating chart

Tables of properties, application techniques, and industrial uses are offered in Catalog 2-55-3M. Twelve pages. AMERCOAT CORPORATION.

515-Control corrosion cathodically

How galvanic corrosion effects metal in contact with earth or water and principles used to halt existent corrosive action are described in Bulletin 4078-HC. Savings in protecting both new and existing installations are discussed. Explains how cathodic protection increases equipment life and eliminates downtime on waterworks, deep well pumps, and storage tank installations. Worthwhile addition to the technical library of any engineer. Twelve pages. THE HARCO CORPORATION.

ELECTRIC DISTRIBUTION

517-Cable raceway for every job

Raceways for cable and conduit for all installation problems are discussed in this bulletin. Globetray can be cut to any length and quickly installed. Complete set of standard fittings is available to permit change of direction or elevation. Horizontal elbows, inside and outside vertical elbows, tees, crosses, covers, and special fastening devices save installation time and labor. Load data is given for typical installations. Eight pages. THE GLOBE COMPANY.

518-Lowdown on dry transformers

The applications, sizes, types, and construction of air-cooled dry-type transformers is described in Bulletin 155. Specifications are included. Special custom-built transformers and reactors are discussed. Eight pages. SORGEL ELECTRIC COMPANY.

519-Heat-resistant cable manual

Data on heat-resistant cables including test results for Keystone butyl rubber insulation are included in Bulletin H-463. Includes performance data under conditions of high heat and extreme moisture. Tables, formulas, graphs and engineering data are included covering all phases of selecting and applying electric conductor cable. Forty-eight pages. "KEYSTONE" HAZARD DIVISION, THE OKONITE COMPANY.

520-How to choose circuit breakers

Essential information on selection and application of molded case and large air circuit breakers is presented in this Speedfax catalog. Application sections use charts and tables to explain selection of circuit breakers for motor circuits, bus duct, conductors, and transformer secondary applications. Includes latest prices, dimensions, and ordering instructions—arranged and indexed to reduce reference time and eliminate errors. Sixty pages. I-T-E CIRCUIT BREAKER COMPANY.

521-Transformer buying guide

Bulletin GEC-1028 contains all vital facts and figures on the company's instrument transformer line. Includes latest additions to the ever-expanding group of butyl-molded current transformers. Contains a wealth of engineering data. Eighty pages. GENERAL ELECTRIC COMPANY.

522-Power connectors technical data

Bulletin 38-E contains pertinent technical information on the use of power connectors. Includes 20 separate resistance and current carrying capacity tables for many materials and connector configurations. Formulas show forces due to short-circuits. Thirty-six pages. DELTA-STAR ELECTRIC DIVISION, H. K. PORTER COMPANY, INC.

FUELS AND FIRING EQUIPMENT

524-Read about fuel oil additives

How to get complete protection from fuel tanks to burner tips is described in Bulletin 5012-A. Additives eliminate desludging operations, keeps screens and burners clean, improve atomization and combustion, eliminate smoke and soot, and reduce rusting, pitting, and leaks. Includes recommended amounts of additive per 1000 gallons of fuel oil. Four pages. DEARBORN CHEMICAL COMPANY.

525-Stokers are more flexible

Stokers for bituminous coal and anthracite are explained in detail with many illustrations in Bulletin 553. Complete specifications and ratings are included. Photographs and drawings of side ash dumps are also given. Twelve pages. CANTON STOKER CORPORATION.

(more basic bulletins on page 44)

Circle 110 on READ-N-CIRCLE card for more data

basic bulletins

. . . starts on page 42

526-Modern ways of burning coal

"Burning Bituminous Coal the Modern Way," contains 24 pages of case histories from industries of all sizes and types. Engineering survey results for equipment include annual fuel consumption and operating costs. BITUMINOUS COAL INSTITUTE.

527-New combustion sampling

Full story of a newly developed sampling system for continuous trouble-free sampling and oxygen measurement of combustion processes is told in Bulletin 703. Equipment described is designed for steam generating plants, rotary kilns and driers, open hearth furnaces, and tanks. ARNOLD O. BECKMAN CO., INC.

HEAT EXCHANGERS

528-Heat exchanger operation

Air-flow diagram in two-page Data Sheet 124 graphically shows operation of the Aero Heat Exchanger for water, oil, or compressed air cooling. How the unit saves cooling water, piping, pumping, and equipment costs is explained. NIAGARA BLOWER CO.

INSTRUMENTS AND CONTROLS

529-Industrial control with Cypak

The "whys" and "wherefores" of static control systems are discussed in Booklet B-6584. Photographs, line drawings, and circuit diagrams discuss systems from four points of view: need for static control, what they are, how they operate, and where they can be used. Discusses how Cypak works, how it is applied, and special results that can be obtained from this system of static control. Six pages. WESTINGHOUSE ELECTRIC CORPORATION.

530-Temperature conversion chart

Handy two-color chart converts degrees Fahrenheit to degrees to Centigrade over the range from −400 to +4000 degrees. It also shows temperature ranges of different sensing elements. Thermocouples, resistance bulbs, and radiation heads are shown, with recommendations for installation and maximum limits for both continuous and intermittent service. A valuable reference chart for all power services engineers. THERMO ELECTRIC CO., INC.

531-How to select thermocouples

Comprehensive discussion of theory and uses of thermocouples is contained in Bulletins 1601, 2, 3, and 4. Thermocouple circuits and metals, immersion length, protecting tube, junctions, extension leads, and terminal connectors are discussed in detail. Recommended operating temperatures and resistance tables are included for most commonly used thermocouples. Shows installation data for measurement of liquid, gas, and surface temperatures. Fourteen pages. REVERE CORPORATION OF AMERICA.

532-Pneumatic systems handbook

Complete discussion of all phases of pneumatic control is contained in Bulletin 1120. Separate sections are devoted to transmission of pneumatic signals, cascade and ratio control, time replay, interconnected control systems, and tuning controllers to your needs. Charts, sectional diagrams, and typical installations are also included. Forty-six pages. MINNEAPOLIS-HONEYWELL REGULATOR CO., BROWN INSTRUMENT DIVISION.

533-Switches insure safe operation

Bulletin 856 contains information on full line of mercury switches and controls. Lists mercury switch controls for temperature, pressure, oil burner controls, stoker, liquid-level, and boiler feedwater pumps. Gives advantages of mercury switches, such as visible contact, elimination of contact wear, and seal from hazardous atmospheres, dirt, and corrosion. Fifty-two pages. THE MERCOID CORPORATION.

FREE COPIES

For free copies of these handbooks, bulletins, and catalogs just circle the key numbers on the READ-N-CIRCLE card on pages 47 or 48.

MAINTENANCE ITEMS

537-Repair methods handbook

Text and illustration in this 48-page handbook present repair methods for leaks in pipes, boilers, radiators, concrete, cinderblocks, and sheet and plate metal. Directory describes 12 typical repair cements and jobs they will do. SMOOTH-ON MFG. CO.

MATERIALS HANDLING (BULK)

540-Control coal dust with ease

How to control coal dust in your coal handling operations is described in Bulletin 551-D. Discusses use of local exhaust ventilation and cloth-tube-type dust collector. Lists applications such as conveying, crushing, weighing, and batching of coal for use in power plant furnaces and boilers. Lists case histories and gives diagrams of well-designed materials handling systems. Four pages. WHEELABRATOR CORPORATION.

541-Story of tile storage bins

"Vitrified Glazed Tile Industrial Storage Bins," four-page Bulletin 1153-B, tells you how this type of bin can keep materials clean, dry, and ready for use. Drawings show how the tiles are constructed and the simplicity of erecting silos made of these tiles. KALAMAZOO TANK AND SILO CO.

542-Pneumatic system principles

"Pneumatic Ash & Dust Handling Systems," seven-page Catalog 652, outlines general principles of pneumatic materials handling and explains how this company's products meet requirements for each application. ALLEN-SHERMAN-HOFF CO.

PIPING, TUBING, AND HOSE

543-Saddle clamps repair pipe leaks

Temporary or permanent repair clamps together with gaskets recommended for use with each clamp are discussed in Bulletin 54. Also describes line of special clamps, including method of application, for welding repairs, service outlets, and vented patches. Featuring a clamp for every leak, booklet is valuable reference in solving your maintenance problems. Thirty pages. M. B. SKINNER CO.

544-Stainless steel piping data

Engineers and designers concerned with stainless piping problems will find valuable data in six-page Bulletin TB-356. It outlines methods of bending and joining stainless pipe and discusses the problems of light wall versus heavy wall pipe with tables of dimensions and weights of various stainless pipe size schedules. THE BABCOCK & WILCOX CO.

PUMPING EQUIPMENT

546-Water pump selection table

Condensed selection table is a valuable guide to horsepower and head-capacity ratings of vertical pumps for industrial primary water supply. Described in Bulletin 100. Sectional illustrations with enlarged views of special features describe pumps clearly. Distribution systems are covered. Eight pages. LAYNE & BOWLER PUMP COMPANY.

547-How to figure pump heads

How to determine total head against which pump must operate is only one of the valuable sections in 12-page Bulletin 353-1000 on the Bilton pump, a general purpose pump suitable for medium and low head service. BYRON JACKSON DIVISION, BORG-WARNER CORPORATION.

550-How to use package feeders

Proportioning pumps and package chemical feeding units are described in this four-page folder. With liquid ends available for about 85 percent of all chemical pumping requirements, the pump is designed for use where a controlled capacity of fluid is necessary. How feeding unit can be connected to piping of your plant and to electrical control equipment is explained. BIRD-ARCHER CO.

551-Sewage and sump pump selection

Comprehensive, eight-page Bulletin 325-A32 is for engineers, architects, and contractors who specify sewage and sump pumps. It describes in detail three types of pumps: The NKS Vertical Wet Pit Single or Duplex; the NKV Vertical Dry Pit; and the NKH Horizontal. AMERICAN-MARSH PUMPS, INC.

REFRACTORIES AND INSULATION

552-Save with engineered insulation

Complete engineering data on installations to control temperatures from −400 F to +3000 F are contained in Bulletin IN-171A. Includes data card giving complete insulation line with recommended temperatures for handy reference. Gives typical installations showing construction methods with results obtained. Lists recommendations for refrigeration sheets, air conditioning ducts, pipe insulation, cement, and fills. Twenty pages. JOHNS-MANVILLE.

553-Refractory construction

The different types of construction considered standard for industrial refractory are described in Bulletin 39. Profusely illustrated. Twenty pages. BIGELOW-LIPTAK CORP.

TRAPS, STRAINERS, AND SEPARATORS

554-Get "bone dry" compressed air

Bulletin describes how ball-float trap eliminates all water and oil from compressed air system. Equipment is entirely mechanical and automatic. Requires no maintenance—has minimum working moving parts. Contains information on line of aftercooler separator filters. JAS. A. MURPHY & CO., INC.

VALVES AND REGULATORS

556-Control valve reference book

Three basic types of single-seated diaphragm control valves are discussed in 15-page Bulletin 5304. Cutaway views and charts with complete specification data make this a good reference book. LESLIE CO.

557-Valve and regulator data

Specifications and operational data for steam, gas, air, oil, and water regulating equipment are presented in 60-page Catalog 54. Illustrations and descriptions are included for pressure, temperature, and combination regulators, diaphragm, float, motor, solenoid, pop, and relief valves. O. C. KECKLEY CO.

558-Why not a solenoid valve?

If you use direct operated solenoid valves for automatic or remote flow control of liquids and steam up to 400 F, or of high viscosity liquids you will want to read 11-page Bulletin V-2. Normally closed, normally open, explosion-proof normally closed, and three way valves are shown. THE JOHNSON CORP.

559-Simple valve cross-index

Valve users can easily obtain data on valves for a wide variety of applications by using the simplified cross index in 27-page Catalog 105. The most widely used cast and forged steel Edward globe and angle stop, nonreturn, check, gate, hydraulic, relief, mudline, blowoff, instrument valves, and strainers are included. EDWARD VALVES, INC.

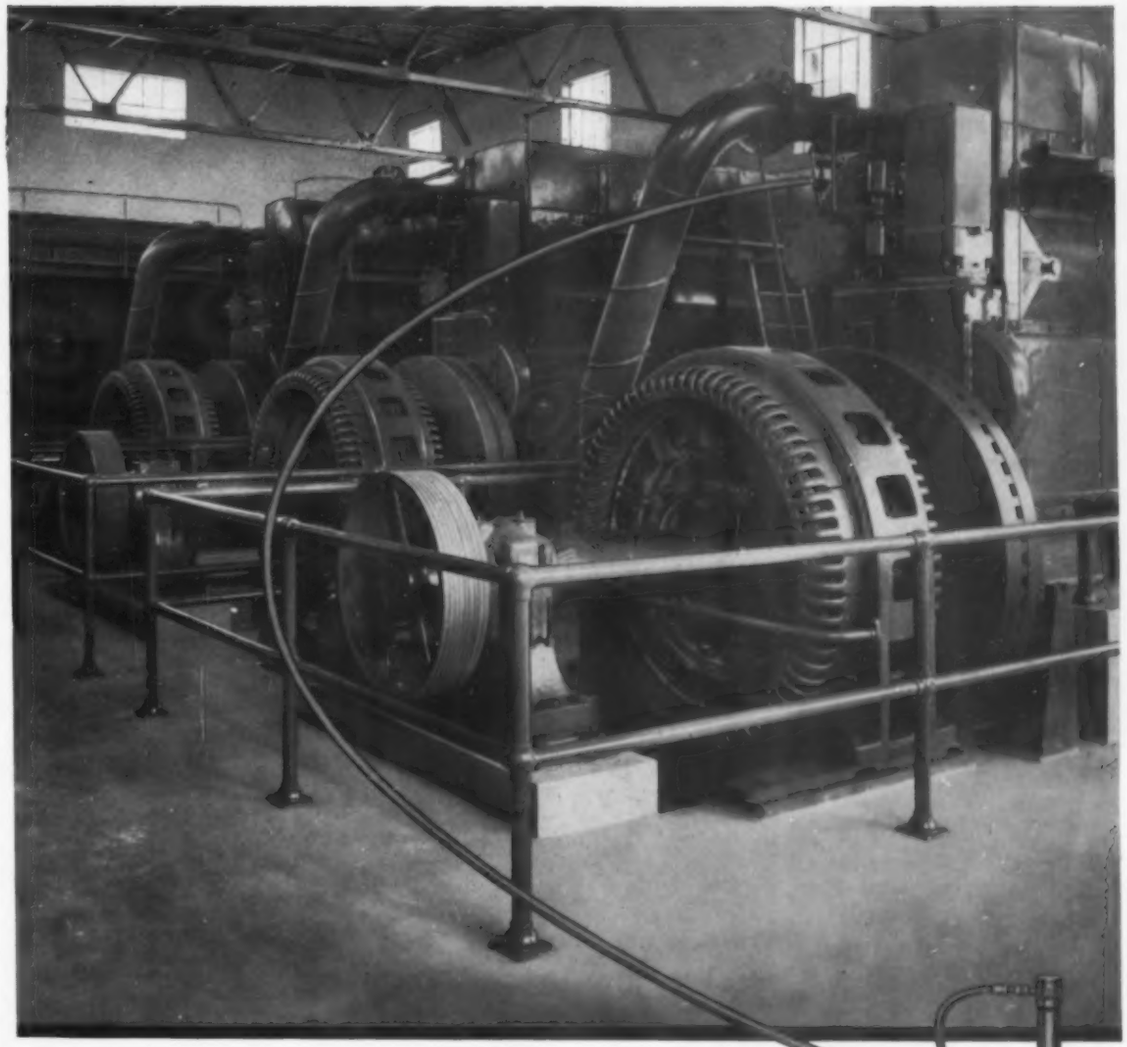
WATER SUPPLY AND TREATMENT

560-Water treatment explained

"Water Conditioning—One Source for Every Need," 19-page Bulletin 611B, presents the wide range of products available from this company and explains how each type solves particular problems. ELGIN REFINITE DIV., ELGIN SOFTENER CORP.

561-Simplify water treatment

Information to accurately select water treating equipment for any plant, industry, or other institution is contained in this bulletin. Three basic exchange materials are described. Includes water and brine distribution mechanism and exchange material depth. Sketches show direction of water and brine flow during service, brine-rise, and regeneration cycle. Contains specifications including flow rates, exchange capacities, amount of salt, and shipping weight. Eight pages. ILLINOIS WATER TREATMENT COMPANY.



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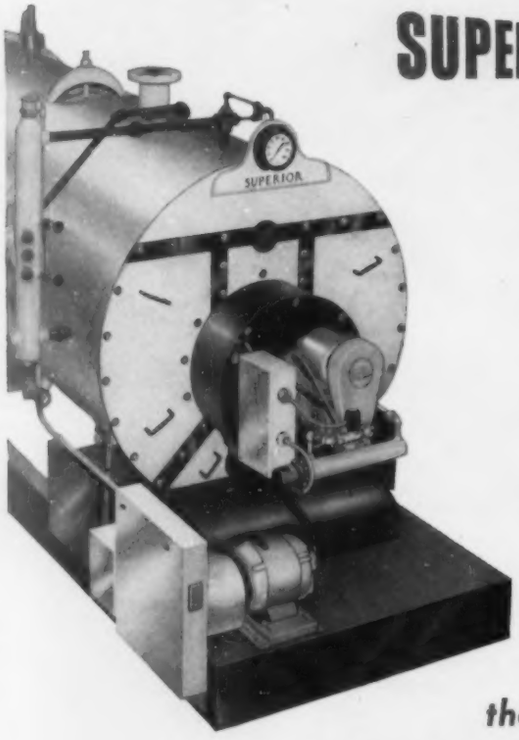

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SUPERIOR STEAM GENERATORS

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names make news

. . . personalities from industry power

American Society of Mechanical Engineering has elevated three men to rank of Fellow. Those honored were: **George A. Hawkins,** dean of engineering, **Purdue University; Milton J. Thompson,** professor of aeronautical engineering and associate director, Defense Research Laboratory, **University of Texas; Ford Lee Wilkinson, Jr.,** president, **Rose Polytechnic Institute.**

Holtzman

Evans

Wagner Electric Corporation elects officers: **J. H. Devor,** president; **G. W. Brown,** and **H. N. Felton,** vice presidents; **J. C. Evans,** controller; **E. G. Holtzman,** secretary-treasurer; and **J. P. Harbacek,** assistant secretary and assistant treasurer.

American Institute of Electrical Engineers elects new officers: **Mervin S. Coover,** associate dean of engineering and professor of electrical engineering at **Iowa State College** becomes 1956-57 president. New vice presidents are: **Donald E. Garr,** general engineering laboratory, **General Electric Company; Leland F. Stone,** apparatus sales office, **General Electric Company; J. H. Foote,** president, **Commonwealth Associates, Inc.; Norman F. Rode,** professor of electrical engineering, **Texas Agricultural and Mechanical College; Mansfield M. Ewell,** engineering & service department, **Westinghouse Electric Corp.; Henry H. Kerr,** vice president in charge of operation, **Toledo Edison Company.** New directors are: **William R. Brownlee, Southern Services, Inc.; Alva A. Johnson,** switchgear division, **Westinghouse Electric Corp.** and **L. M. Robertson,** chief electrical engineer, **Public Service Company of Colorado. Walter J. Barrett, New Jersey Bell Telephone Company,** becomes treasurer.

Western Precipitation Corporation appoints **L. J. Dusenbury** head of Proposal and Contract Department. Dusenbury joined Western Precipitation in 1952 after serving as consultant in the power plant field. Dusenbury's duties will consist of all estimating, pricing, proposals, and contract administration for sales of Cottrell precipitators.

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THE NORTHERN BLOWER COMPANY. Get dust collection around the clock without interruption by using Norblo automatic bag-type arresters.

Clean up coal handling
Read page 8 and circle number 101
JOHNSON MARCH. An engineered liquid dust-control system will eliminate troublesome coal dust in all stages of your coal handling.

AIR CONDITIONING, HEATING, VENTILATING

Save with gas unit heaters
Read page 37 and circle number 102
REZNOR MANUFACTURING COMPANY. Mail coupon for more information on how you can save by using gas unit heaters if your boiler is becoming inefficient.

Don't be let down for fresh air
Read page 2 and circle number 103
COPPUS ENGINEERING CORP. Maintenance men work faster, do better work, and work longer without fatigue when they are fed better air.

Reduce air-conditioning costs
Read page 40 and circle number 104
RUPPRIGHT ROTARY ROOF COOLER. Here's an economical way to cool your building and reduce air conditioning costs. Easily installed—can be used on any roof.

BOILERS AND BOILER ACCESSORIES

Continuous blowdown without heat loss
Read page 42 and circle number 105
HENSZEY COMPANY. Write for more information on how you can insure automatic control of boiler water concentration.

Repeat business is the proof
Read pages 6, 7 and circle number 106
BABCOCK & WILCOX BOILER DIVISION. Take a tip from the old customers who always specify B & W Integral-Furnace Boilers.

Can you afford to wait for steam?
Read page 55 and circle number 107
AMES IRON WORKS, INC. Mail coupon for information on how you can be sure of having steam in large quantities when you need it.

Built-in induced draft
Read page 46 and circle number 108
SUPERIOR COMBUSTION INDUSTRIES INC. These are the only package boilers to give you benefits of an integrated induced draft system.

Portable steam generators
Read page 51 and circle number 109
AUTOMATIC STEAM PRODUCTS CORP. If you need a compact, portable, electric operated high- or low-pressure steam generator, investigate the Hot Shot.

Hot water fast
Read page 43 and circle number 110
PICK MANUFACTURING CO. Pick instantaneous hot water heaters are engineered for service. Write for booklet on how Pick heaters cut hot water costs.

BUILDING CONSTRUCTION, MAINTENANCE

Fabrication in any metal
Read page 35 and circle number 111
THE KIRK & BLUM MFG. CO. Send for free copy of sheet and plate fabrication booklet, and read how this experienced fabricator can meet your every need.

ELECTRIC DISTRIBUTION

Do you want higher voltage distribution?
Read page 27 and circle number 112
SORGEL ELECTRIC CO. Use higher voltage distribution with dry-type transformers at load centers and get both efficiency and economy.

Use a smaller circuit breaker
Read page 4 and circle number 113
I-T-E CIRCUIT BREAKER COMPANY, SMALL AIR CIRCUIT BREAKER DIVISION. Send for more information on new M-frame molded case circuit breakers, which are fully designed for 800-ampere applications.

Reduce fire hazards and downtime
Read pages 52, 53 and circle number 114
BUSSMAN MFG. CO. Write for bulletin about fuses that provide 10-point protection.

FUELS AND FIRING EQUIPMENT

Cost-cutting baffles
Read page 35 and circle number 115
THE ENGINEER CO. Save fuel and reduce maintenance with Enco boiler baffles. Designed by specialists.

Have you all the facts?
Read page 25 and circle number 116
MICHIGAN OVEN COMPANY. Send for this book of basic heat processing information written by the specialists — you'll find it useful.

INSTRUMENTS AND CONTROLS

Double check boiler water level
Read page 49 and circle number 117
THE RELIANCE GAUGE COLUMN CO. Sound

Two watch dogs...twice as good as one...

Let the Reliance Safety Team give you a double check on boiler water levels

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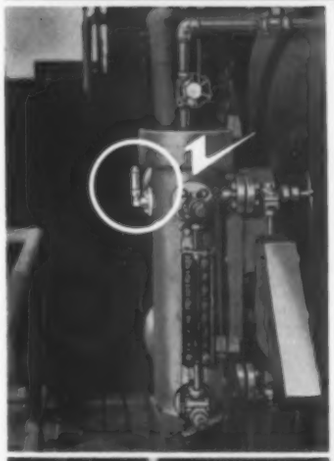
Remote Gage



This team works for thousands of plants like yours. It double checks boiler water levels—helps you achieve more efficient operation, lower power cost, greater safety. The sensitive float-operated mechanism in the Alarm Water Column sounds a last-resort warning (see whistle) when water approaches low or high danger points. But for minute-by-minute scanning by operators, EYE-HYE beams its bright picture of true water level condition from a convenient eye-level position. It's the original remote reading gage — all-hydrostatic, simple, sure.

Now...alarms on pressures to 2500 lbs.!

Steam whistles are available on Reliance water columns up to 900 psi only. But with the Reliance Levalarm EA17 you can have vibratory horns or warning lights or both, to assist EYE-HYE in water level "watch dog" service. It pays you to have the Reliance Safety Team for adequate boiler water level supervision. Write for details — or ask your Reliance Representative.

The Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland 3, Ohio

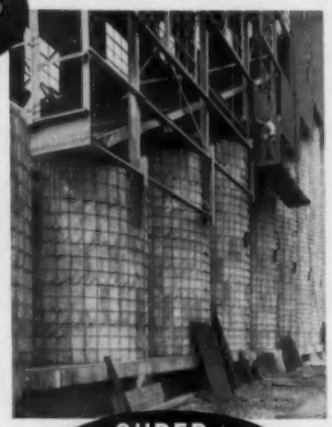
The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES

Circle 117 on READ-N-CIRCLE card for more data

16
NEFF & FRY BINS
IN THIS GROUP



These bins are used for handling silica sand. They range in size from 18′ dia. x 52½′ high to 12′ x 12½′. Machinery for screening and grading the sand is mounted directly on the bins without extra supports, proving the load-bearing strength of Neff & Fry construction.

Thousands of Neff & Fry Bins are being used for handling and storing nearly a hundred different kinds of bulk materials, including grain, coal, seeds, minerals, chemicals, clay, wood chips, etc.

Before you decide on storage bins, ask us for complete information. Read our folder, "Bins With the Strength of Pillars." Our bins will likely save you money on first cost, and certainly on maintenance.

SUPER-
CONCRETE STAVE
STORAGE BINS

NOT EXPORTED EXCEPT TO CANADA AND MEXICO.

The Neff & Fry Co. • 120 Elm St. • Camden, Ohio

Circle 128 on READ-N-CIRCLE card for more data

NON-FLUID OIL
TRADE MARK REGISTERED

GIVES CONSTANT PROTECTION
TO ANTI-FRICTION BEARINGS

When NON-FLUID OIL enters a bearing, it instantly forms a tenacious film, assuring positive protection against frictional wear, pitting rust and corrosion.

At high or low speed, NON-FLUID OIL lubricated bearings run cooler and smoother, without drip or spatter. They require lubrication only one third as frequently as with ordinary greases — which leave gummy, acid forming residues, causing heating and pitting.

Send for your free testing sample today. A copy of our bulletin on bearing lubrication and maintenance will also be sent . . . no obligation, of course.

NEW YORK & NEW JERSEY LUBRICANT COMPANY
292 MADISON AVE., NEW YORK 17, N.Y.
WORKS: NEWARK, N. J.
WAREHOUSES
Birmingham, Ala. Columbus, Ga. St. Louis, Mo.
Atlanta, Ga. Springfield, Mass. Providence, R. I.
Charlotte, N. C. Detroit, Mich. Chicago, Ill.
Greenville, S. C. Greensboro, N. C.
Also represented in other principal cities.

1886 60 YEARS 1946 — SIXTY YEARS OF LUBRICATION SERVICE TO INDUSTRY

NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture.

Circle 121 on READ-N-CIRCLE card for more data

handy guide

. . . starts on page 49

check and sight check your boiler water levels for more efficient operation, greater safety.

Water gages from stock
Read page 40 and circle number 118
ERNST WATER COLUMN & GAGE CO. Stainless steel or iron gages with ½-inch or ¾-inch connections are always available from stock.

Measure liquids accurately
Read page 11 and circle number 119
BUFFALO METER CO. Mail coupon for complete information on accurate measurement of process liquids.

Safe boiler control
Read page 24 and circle number 120
MAGNETROL, INC. Control boiler water level with exclusive Magnetrol three-switch design. Mail coupon for free data.

LUBRICATION

Positive protection for bearings
Read page 50 and circle number 121
NEW YORK & NEW JERSEY LUBRICANT COMPANY. Send for free test sample of the oil that will positively protect your bearings against frictional wear, rust, and corrosion.

Avoid stuck rings
Read page 45 and circle number 122
SINCLAIR REFINING COMPANY. Cut maintenance costs on diesel performance by specifying Rubilene oils.

Stop harmful deposits
Read page 56 and circle number 123
THE TEXAS COMPANY. Assure yourself a full-power, dependable performance at low maintenance costs by using Ursa oils.

MAINTENANCE ITEMS

Lasting repairs for pennies
Read page 28 and circle number 124
SMOOTH-ON MANUFACTURING CO. Keep this wonder cement on hand for emergency repairs — it will not deteriorate.

Pipe threader deluxe
Read page 5 and circle number 125
THE TOLEDO PIPE THREADING MACHINE COMPANY. You can change dies instantly on these improved small ratchet pipe threaders.

Having troubles with packing?
Read page 54 and circle number 131
JOHNS-MANVILLE. There's a J-M packing that will give you longer life in reciprocating service, regardless of temperature.

Cut costs on tube removal
Read page 37 and circle number 126
AIRETOOL MANUFACTURING COMPANY. You can accomplish overhauls in jig time with this internal tube cutter. Send for literature.

Planned maintenance helper
Read page 51 and circle number 127
GRAPHIC SYSTEMS. Boardmaster Visual Control gives graphic picture of your operations.

MATERIALS HANDLING (BULK)

Stronger storage bins
Read page 50 and circle number 128
THE NEFF & FRY CO. Before you decide on storage bins, investigate these super concrete-storage bins.

Handling bulk materials?
Read page 29 and circle number 129
CANTON STOKER CORP. Flo-tubes will handle fine or lumpy materials on any incline. Guaranteed by specialists in the field. Write for full story.

TRAPS, STRAINERS, AND SEPARATORS

Performance guaranteed
Read page 22 and circle number 130
JAS. A. MURPHY & CO. These entirely automatic ball float traps are fully guaranteed.

VALVES AND REGULATORS

Twelve years without maintenance
Read page 10 and circle number 132
CRANE CO. You, too, can get 12 years of valve life on feedwater service without repairs or maintenance.

These new valves don't leak
Read page 29 and circle number 133
REPUBLIC MANUFACTURING CO. Seal-Tite pressure-balanced valves will handle liquids to 1000 psi with zero leakage.

Guaranteed reducing valve
Read page 39 and circle number 134
LESLIE CO. You can put this pressure reducing valve on the line and forget it for at least three years — performance guaranteed.

WATER SUPPLY AND TREATMENT

Test your own water
Read page 26 and circle number 135
SALEM-BROSIUS, INC. Get fast, economical, and accurate bacteriological analysis of water with a Sabro portable laboratory.

Pioneering water conditioning
Read page 9 and circle number 136
W. H. & L. D. BETZ. New techniques in water conditioning that reduce costs, save time, and aid production are being pioneered by Betz. Send for information.

Demineralizers built in all sizes
Read page 22 and circle number 137
HUNGERFORD & TERRY, INC. A complete line of water conditioning systems is available.

reprints available

. . . from industry power

Special Report reprints

Individual copies of Special Report Reprints will be sent free upon request. Additional copies are priced as follows: 2 to 24 copies are 25¢ each; 25 to 49 copies are 20¢ each; 50 to 99 copies are 15¢ each; more than 99 copies are 10¢ each. Special Report Reprints available are:

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- *Contaminants in the Air*
- *Demineralization—A Means to Purer Water*
- *Industrial Waste Treatments*
- *Inplant Electric Distribution*
- *Review and Forecast, 1956*
- *A Thermodynamics Refresher (Complete Set I-VII)*

Single copies of following reprints are available free. Quantity orders for individual reprints quoted on request. Address all correspondence, on company letterhead, please, to Reader Service Department INDUSTRY POWER, Commercial Bank Building, St. Joseph, Michigan.

- *Automatic Control for Variable Speed Transmissions*
- *Big Savings for a Small Plant*
- *Coal Dust . . . Stopped Before It Starts*
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- *Eliminating Expansion Joint Maintenance*
- *For Better Lighting at Less Cost, Frost Your Windows*
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Cool your plant with central units

How one plant saves valuable work space, yet maintains good control. Central units strategically spotted around plant make it possible.

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INDUSTRY POWER

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- *Selecting Fuel and Firing Equipment*
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MAGNIFYING
HIGH PRESSURE GASKETS
All sizes to fit your gages
ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

complete Anhydrous Ammonia and L.P. Gas plants
designed - installed
H. Emerson Thomas & Associates, Inc.

PROPANE GAS PLANTS
and
Anhydrous Ammonia Plants
PEACOCK CORPORATION
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FOSTER QUALITY
FULLY GUARANTEED
RELAYING RAILS
Handle more cars better—cost less to install and maintain. Foster stocks all Rail Sections 12# thru 175#, Switch Material and Track Accessories.
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★ Gives Graphic Picture—Saves Time, Saves Money, Prevents Errors
★ Simple to operate—Type or Write on Cards, Snap in Grooves
★ Ideal for Production, Traffic, Inventory, Scheduling, Sales, Etc.
★ Made of Metal Compact and Attractive. Over 60,000 in Use
Full price $49.50 with cards
FREE 24-PAGE BOOKLET NO. P-60 Without Obligation
Write for Your Copy Today
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55 West 42nd Street, New York 36, N. Y.
Circle 127 on READ-N-CIRCLE card

When you need a compact, portable, electrically operated source of...
HIGH or LOW Pressure STEAM
HOT SHOT SUSSMAN T.M.
ELECTRIC STEAM GENERATORS
are available in all sizes—for every conceivable purpose!
Used by the leaders of industry throughout the world—Since 1917

Ask your supplier, or write direct stating your needs—
AUTOMATIC SUSSMAN STEAM PRODUCTS CORP.
140 West 31st St., New York 1, N. Y. BR. 9-9736
Circle 109 on READ-N-CIRCLE card

ASME Spring Meeting

. . . starts on page 31

"Maintenance costs have been established at approximately $1.50 per installed kw per year on a unit of this size and type. Availability records in excess of 8300 operating hours per year, including a complete plant inspection of two weeks, has proven it to be a dependable and reliable power plant."

Appraisal of nuclear versus hydro power in the Pacific Northwest

K. M. McCaffree, Assistant Professor of Economics, University of Washington.

"Nuclear power undoubtedly will become, at some time, a source of electric energy in the Northwest. The hydroelectric power potential is obviously limited by the physically available sites and water resources, and, given any rate of growth in power needs in the region, eventually would be exhausted. Furthermore, the supply of fossil fuels for conventional steam-generating plants is also limited in the United States, and at some time new energy sources must be developed. However, the physical limitation on hydro sites and the eventual exhaustion of conventional energy sources undoubtedly will not be reached before atomic power facilities have been built which can compete costwise with the less economical water resources and low-grade conventional fuels.

"Comparison of capital investments suggests that any dam site with capital costs of installed capacity of less than $300 per kilowatt would probably be more feasible than nuclear power plants at $200 per kilowatt. If low rates of interest are available, and reactor life is relatively short, hydro projects as high as $500 per kilowatt of installed capacity could provide electricity as cheaply as nuclear plants at $200 per kilowatt. . . .

"Even though dam locations may be judged economically feasible, complications may arise from purely political sources which will prevent their exploitation. The difficulties of international agreement over the division of power rights and the allocation of costs of the projects are many and complex. Furthermore, the domestic issue of public versus private financing and control of the big dams, as well as the questions of jurisdiction over certain sites by particular governmental agencies and/or private and public utilities may further delay hydro development. These factors do not appear to operate against the growth of nuclear power sources. In fact, it may be for political reasons, in the interests of international policy, national defense interests, that nuclear power development will be pushed far ahead of its expected normal economic growth."

. . . "After these two experiences with FUSETRON dual-element Fuses, we use them throughout our Entire Plant."

J. W. Sanders, CHIEF ELECTRICIAN
(Division of Simmons Co.) ROSEMARY MFG. CO.
ROANOKE RAPIDS, N. C.

"SOLENOIDS WERE BURNING UP AND STARTING *FIRES — Until we changed to FUSETRON FUSES.*"

"A fire in our weaving room is just about the gravest danger we can face. If the fire isn't checked immediately, it can quickly spread throughout the room.

"You can imagine then how concerned we were with fires started by solenoids burning up in heavy lint locations. With 500 looms in use in 3 weaving rooms, we didn't know where to expect the next fire.

1

"We definitely had to find safer solenoid protection than we were getting from one-time ordinary fuses in use. We decided to try Fusetron dual-element fuses and installed them in the summer of 1954.

"It was a big relief when Fusetron fuses turned out to be the answer. I'll knock on wood, but we haven't had a fire since we installed them.

"In addition, this move to Fusetron fuses also cut production costs. We eliminated needless down-periods and we no longer have to repair or replace burned-out solenoids."

"WE CUT UNNECESSARY DOWN-TIME AND MAINTENANCE *COSTS By installing FUSETRON FUSES.*"

"Several years ago we had a heating problem in our main panels that was causing ordinary renewable fuses to blow.

"These outages occurred several times weekly in each panel, so down-time costs were really adding up and costing our company money.

"Also, after each blow our maintenance men would spend time checking the circuit for trouble, only to find the outage was caused by excessive heating in the panel.

2

"We discussed the situation with a salesman and he showed us that Fusetron dual-element fuses were cooler operating and would eliminate our trouble.

"They sure did! The change to Fusetron fuses of proper size for safe protection was completed in 1953. We haven't had any unnecessary shut-downs since then.

"Our maintenance men sure like the change. Any outage today indicates trouble, and the men know they are not wasting time when they check the circuit.

"Because of this and other satisfactory experiences with Fusetron fuses, we individually protect all our motors with them as well as using them throughout the rest of the electrical system.

"I wish we had kept a record to show how much money we saved by equipping each motor with Fusetron fuses. I am reasonably certain that the difference in motor burnouts alone would represent considerable money."

You too, CAN REDUCE FIRE HAZARDS AND DOWN-PERIODS by installing FUSETRON FUSES!

They provide 10 Point Protection

1. High interrupting capacity—protect against heaviest short-circuits. Have proven on tests to open safely on circuits set to deliver in excess of 100,000 amperes.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating—lesser resistance results in cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloads.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

Write for bulletin FIS.

FOR LOADS ABOVE 600 AND UP TO 5,000 AMPS., Use BUSS Hi-Cap Fuses . . .

They have an interrupting capacity sufficient to handle any fault current regardless of system growth.

They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuit of origin.

Write for bulletin HCS.

J. W. Sanders
CHIEF ELECTRICIAN

Play Safe! Install FUSETRON dual-element Fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

BUSSMANN MFG. CO. Div. McGraw Electric Co.
University at Jefferson St. Louis 7, Mo.

706

Circle 114 on READ-N-CIRCLE card for more data

good books

. . . for industry power

Readers wanting to obtain copies of these books may order through INDUSTRY POWER. *Send check covering cost and we will forward your order to the publisher.*

Proceedings, World Symposium on Applied Solar Energy, by The Association for Applied Solar Energy; Jorgenson & Co.; 304 pages; $5.00.

Contains a complete, unabridged selection of the papers presented at the Applied Solar Energy Symposium, November 1955 at Phoenix, Arizona. Text and illustrations discuss all phases of solar energy in easy-to-read form. Includes discussion of economics, uses (including commercial and residential, cooling, agricultural and conservation). Papers are also included that deal with "electricity from the sun," and research results in the USSR.

Typography and illustrations are above average and readability is excellent. Extensive bibliographies are contained for further information on any phase of the particular subject discussed.

Instruments for Measurement and Control, by Werner G. Holzbock; Reinhold Publishing Corp.; 416 pages; $10.00.

This book describes, illustrates, and compares all recently developed industrial instruments used for remote reading or remote automatic action. Separate chapters are included for measuring and controlling temperature, humidity and moisture, pressure, flow, liquid level, density, viscosity, and speed. Discusses in nontechnical language, the construction and operation of instruments for measurement and control of process variables. Compares various instruments and points out factors to consider in choosing proper instrumentation for a particular job.

Subsequent chapters describe devices used in controller action and in final control elements such as valves, pumps, electric transformers, and motors. Special chapter is included that discusses centralized system development, miniaturization, and digital computors. A recommended addition to the library of all power services engineers.

Electric Generation: Steam Stations, edited by B. G. A. Skrotzki; McGraw-Hill Book Company; 454 pages; $8.50.

This book is one of two books that give a practical knowledge of the design, operation, and maintenance of equipment that makes up an electric supply system. Describes basic principles of steam-electric generating stations, which provide most of the electric energy in the United States. Gives facts on selection of fuel, fuel handling and firing, and design and operation of steam generators. Includes a simple nontechnical introduction to steam tables used to calculate and design steam equipment. Covers piping, turbines, condensers, and boiler feedwater treatment. Also describes instrumentation and automatic control systems for electric generators, station electric circuits, auxiliary systems, and superpressure steam stations.

Typography and illustrations are well organized. Wide use of schematic diagrams and cutaway illustrations present technical information in nontechnical manner.

Which packing
for longer life in reciprocating service?

To 500F it's J-M Interlocked

because it cannot ravel or come apart

Made by an exclusive J-M process, Interlocked packing is braided from tough long-fibre asbestos yarns strongly interlocked in a solid integral structure. There are no jackets to wear through . . . no plaits to loosen. That's why it retains its strength and efficiency far longer than other types.

Interlocked also seals better. It is flexible and resilient, braided square for better contact and requires less gland pressure. Style 255 is effective against steam, hot or cold water, oil, weak acids and caustics. Furnished lubricated and graphited in ring and coil forms in sizes from ¼" and up.

To 750F it's J-M Superheat

because it does not harden under high heat

Designed specifically for superheated steam between 500F and 750F, Johns-Manville's Superheat packing is made of highest quality pure asbestos cloth which retains its resiliency even after long exposure to high temperatures. Woven tight, spiral wrapped and then pressed square, this cloth forms a firm resilient structure of superior strength and wearability.

Style 167 Superheat is bonded with a special heat resistant compound. No excess is present to carbonize in use. Density is carefully controlled for minimum gland pressure. Furnished graphited in ring and coil forms in sizes from ¼" and up.

Your local J-M distributor carries full stocks of Interlocked and Superheat and other packings. Call him today or write Johns-Manville, Box 60, New York 16, N. Y. In Canada, Port Credit, Ontario.

Johns-Manville PACKINGS, GASKETS and TEXTILES

Circle 131 on READ-N-CIRCLE card for more data

coming events

. . . for industry power

Sept. 10-12	ASME Fall Meeting	Denver
Sept. 17-21	ISA 1956 Conference and Exhibit	Coliseum New York City
Sept. 17-21	Illuminating Engineering Society National Technical Conference	Hotel Statler Boston
Sept. 25-27	Third Annual Conference Atomic Industrial Forum	Morrison Hotel Chicago
Oct. 1-5	AIEE Fall General Meeting	Morrison Hotel Chicago
Oct. 8-10	ASME Lubrication Conference	Atlantic City New Jersey
Oct. 11-12	Armour Research Foundation National Noise Abatement Symposium	Sherman Hotel Chicago
Oct. 18-19	Armour Research Foundation National Conference on Industrial Hydraulics	Sherman Hotel Chicago
Oct. 22-24	Seventeenth Annual Water Conference	Hotel Wm. Penn Pittsburgh
Oct. 24-25	ASME Fuels Conference	Washington, D.C.
Nov. 25-30	ASME Annual Meeting and Power Show	Hotel Statler and Coliseum New York City

next month in
INDUSTRY POWER . . . .

winter's on its way....
get your unit heaters ready

Now is the time to get set for winter, difficult though it may be to be concerned about cold weather during these hot summer days. But you can bet that you will need your unit heaters in top working order next winter as surely as you can bet that tomorrow may be a scorcher.

To help you get ready before the "heat's on" in your area, INDUSTRY POWER will give you a complete rundown on all you will need to do to be ready for winter. Material comes from outstanding industry authority. And it will come to you in plenty of time to get the work done before that "last minute" creeps up on you. Watch for the

August issue of
INDUSTRY POWER

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Thomas C. Wilson ..... *

Yarnall-Waring Co. ..... *

Where an * appears after a name the advertisement does not appear in this issue, but appeared in one or both of the two previous issues.

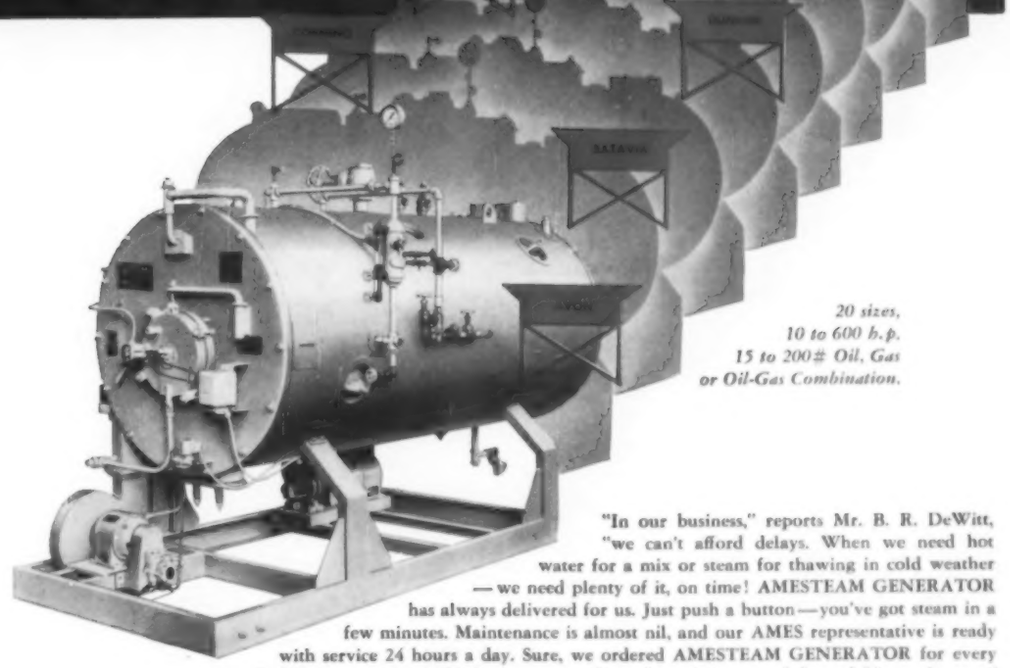
FOR EVERY NEW CEMENT PLANT

B. R. DeWITT, INC.

Prominent N. Y. State Road Builders

ORDERED A NEW

AMESTEAM GENERATOR



20 sizes, 10 to 600 h.p. 15 to 200# Oil, Gas or Oil-Gas Combination.

"In our business," reports Mr. B. R. DeWitt, "we can't afford delays. When we need hot water for a mix or steam for thawing in cold weather — we need plenty of it, on time! AMESTEAM GENERATOR has always delivered for us. Just push a button — you've got steam in a few minutes. Maintenance is almost nil, and our AMES representative is ready with service 24 hours a day. Sure, we ordered AMESTEAM GENERATOR for every new DeWitt cement plant. We know we can depend on their rugged dependable equipment."

"REPEAT" ORDERS

like those of B. R. DeWitt, Inc., Pavilion, N.Y. Road Builders, are continual proof of user satisfaction with AMESTEAM GENERATORS.

2 MORE ORDERED

Besides the seven units in DeWitt plants, Mr. DeWitt has ordered and just taken delivery on two additional units for new plants in the vicinity of Rochester, N.Y. The 9 AMESTEAM GENERATORS range in size from 40 to 80 h.p.

For satisfaction like this — for dependable steam production and economy over the years — you take no chances when you specify AMESTEAM GENERATOR!

MAIL COUPON TODAY!

AMES IRON WORKS, INC.
BOX F-76, OSWEGO, N.Y.

Gentlemen:

Please send me further information on AMESTEAM GENERATORS and name of the nearest representative.

NAME .....

COMPANY .....

ADDRESS .....

AMES IRON WORKS INC.
BOX F-76 OSWEGO, N.Y.

Circle 107 on READ-N-CIRCLE card for more data